Proceedings of the International Occupational Classification Conference

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U.S. Department of Labor
Robert B. Reich, Secretary

Bureau of Labor Statistics
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Preface

These *Proceedings* contain the papers, discussant comments, panelist remarks, and audience discussions presented at the International Occupational Classification Conference, held June 22–24, 1993, in Washington, DC. This conference was sponsored by the Bureau of Labor Statistics (BLS), at the request of the Office of Management and Budget (OMB), to introduce the revision of the Standard Occupational Classification system.

Numerous staff members from the Bureau of Labor Statistics made significant contributions to the successful planning and implementation of the conference. The conference program participants—paper presenters, panelists, session chairpersons, and international experts—provided valuable insights into the challenges confronting the classification of occupations and potential solutions to these challenges.

Acknowledgments

The Bureau of Labor Statistics prepared and copy edited this publication. Many individuals in BLS contributed to the preparation of these *Proceedings*. Michael McElroy, a supervisory economist in the Office of Employment and Unemployment Statistics, served as the chairperson of the committee which organized the conference. The economists who reviewed the works for economic content include: Cathy A. Baker, Joseph Bush, Monica D. Castillo, Brett Illyse Graff, Paul Hadlock, Michael Hazzard, Jeff Johnson, Laura T. Ross, Katherine Singleton, Barbara H. Wootton, and William Ziss. The staff of the Office of Publications, particularly Jerry L. Matheny and Eugene H. Becker, provided editorial and publications assistance.

A special note of thanks is in order for the expeditious manner in which conference participants reviewed their contributions to the *Proceedings*. This, together with the efforts of BLS staff resulted in the early publication of this volume.

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Contents

Page

Introduction 1

Welcome 3
William G. Barron, Acting Commissioner, Bureau of Labor Statistics 4
Robert B. Reich, U.S. Secretary of Labor 6
Why redo the standard occupational classification system?, Thomas J. Plewes 9
Economic concepts for economic classifications, Jack Triplett 11

Module 1. Perspectives of current occupational classification systems 15
The 1980 standard occupational classification, Brian MacDonald and Paul Hadlock 16
General schedule position classification, Raymond Moran 21
Summary of occupational classification requirements, William R. Bailey 23
Census occupational classification system and the standard occupational classification, Thomas Scopp and John Priebe 26
The occupational employment statistics program occupational classification, Michael P. McElroy 38
Discussion 43

Module 2. New challenges and alternative approaches to occupational classification 47
Future use of the SOC, Mark Drase, Odessa Dubinsky, Daniel Flaming, and Robin Law 48
Uses of an occupational classification system, Seymor L. Wolfbein 115
Concepts for an ideal standard occupational classification system, Joel Popkin 124
Alternative approaches to classifying occupations, Mark A. Loewenstein and Marilyn E. Manser 142
Classification schemes and the study of social mobility: a detailed examination of the Blau-Duncan categories, Daniel H. Krymkowski, Zbigniew Sawinski, and Henryk Domanski 157
Intuitive classification of Occupation, Frederick Conrad, Bruce Tonn 169
Discussion 179

Module 3. User needs and different experiences with different occupational classifications systems 183
Consumer criteria for the next standard occupational classification, Alan L. Moss 184
Performing a national job analysis study, Robert C. Korte, Beverly Nash, and Jodi Smith 190
Voluntary skill standards and occupational classification, James D. Van Erden 193
Discussion 198

Module 4. Possibilities for a unifying classification system 201
Analytical problems stemming from surveys having different occupational classifications, Neal H. Rosenthal 202
Recommendations concerning the *Standard Occupational Classification* and the *Dictionary of Occupational Titles*, Donna Dye 206
The case for revising U.S. occupational classification systems, David W. Stevens 212
An occupational classification system for collecting employment data from both households and employers, Richard Dempsey 235
Discussion 251

Module 5. International perspectives on occupational classification 253
Australian standard classification of occupations conceptual framework and directions for the second edition, Richard C. Madden and Siu-Ming Tam 254
Some issues related to occupational classifications, Olivier Bertrand 269
The Netherlands standard classification of occupations 1992, Bart F. M. Bakker 272

Contents—Continued

	Page
Polish experience in the application of occupational classifications, Maria Bulinska and Janusz Witkowski	282
The United Kingdom's standard occupational classification, Ian White	290
Developing an occupational classification system for the European Community: efforts to harmonize national systems, Peter Elias	295
The standard occupational classification 1991: statistical considerations in developing a classification of occupations, Shaila Nijhowne and Wayne Silver	299
The national occupational classification of Canada, Margaret Roberts	320
Ohio's adoption of Canada's jobscan skill checklists, Dixie Sommers	322
Innovations in occupational classification: international lessons for revising the U.S. standard occupational classification system, Barbara H. Wootton	326
Discussion	334
Where do we go from here?	341
Katherine Wallman	342
Daniel H. Weinberg	344
Raymond Uhalde	346
Thomas J. Plewes	348
Comments submitted by attendees after the conference	351

Introduction

Recent concern with the quality of the U.S. workforce, skill formation issues, and changes in occupational structures due to new technology and shifts to high-performance work organizations, highlight the importance of accurate, timely, and comparable occupational information to support program planning, career guidance, and training development. As such, many users and producers of occupational data feel that it is time to re-examine the Standard Occupational Classification (SOC) and to develop a classification structure that meets the occupational information needs of the twenty-first century.

Historically, various U.S. Federal agencies, primarily the Department of Labor and the Bureau of the Census, have developed their own separate occupational classification systems, designed to meet their own specific statistical and programmatic needs. The lack of comparability between these various sources of occupational information and data led to multi-agency interest in and action to develop a Standard Occupational Classification system, beginning in 1966. The SOC, first published in 1977 and revised once in 1980, was intended to provide a mechanism for cross-referencing occupation-related data collected by various economic and social statistics programs in order to maximize the analytical utility of these data.

The SOC never was implemented fully across all Federal occupation-related data collection efforts, however. In addition, the 1980 version of the SOC is outdated, as new occupations have emerged since that time. In November 1991, the Office of Management and Budget (OMB) designated the Department of Labor as the lead agency to coordinate the development of a new U.S. Standard Occupational Classification system by 1997. Since that time, the Office of Employment and Unemployment Statistics of the Bureau of Labor Statistics and the Dictionary of Occupational Titles (DOT) staff of the Employment and Training Administration (ETA) have been working together to organize activities aimed at developing information and alternative approaches related to classification principles for the new SOC. These activities have included commissioning papers on major occupational classification issues and soliciting contributions of papers on other specific topics.

BLS sponsored an International Occupational Classification Conference, held June 22–24, 1993, in Washington, DC, at which the commissioned and contributed papers were presented. The Conference provided a forum for the discussion of new ideas and alternative approaches to occupational classification issues and served to introduce revision activities for the U.S. SOC. The Conference included many of those persons and agencies directly involved with the user community of occupational classifications. The approximately 100 participants represented statistical agencies from a variety of countries, academia, State-level interests, professional associations, and all relevant Federal agencies.

At the conclusion of the conference, heads of the major Federal agency offices responsible for the development and maintenance of the SOC—the Office of Management and Budget, the Bureau of Labor Statistics, the Bureau of the Census, and the Employment and Training Administration—participated in a panel discussion. This session summarized the lessons from the conference and plotted out the direction that these major players must move in, together, to revise the SOC to meet the occupational information needs of the twenty-first century.

This volume contains the conference presentations and is organized in the same manner. Each section presents papers or panelist remarks, discussant and author comments, and audience comments. Section I is comprised of three introductory presentations about why it is time to revise the SOC. Section II contains six presentations that provide a perspective on the current structure and use of various U.S. occupational classification systems. Another six papers make up section III. It looks at new challenges and alternative approaches to occupational classification. Section IV includes three presentations on user needs and occupational classification systems. Four papers on the possibility of developing a unifying occupational classification system in the U.S. are presented in section V. Section VI contains eight presentations by international experts on innovations in occupational classification in other countries, as well as two presentations related to how the United States can learn from the international experience. The ideas of the panel of agency leaders responsible for the SOC concerning the future direction of the SOC revision effort are contained in section VII. The final section includes comments on occupational classification that were submitted by conference participants who did not have the opportunity to make a presentation at the conference.

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Welcome

Introduction

The presentations in this opening session focus on the importance of occupational classification and why the U.S. Standard Occupational Classification System is in need of an overhaul. Secretary of Labor Reich describes recent changes in the economy and technology and their effects upon the structure of occupations, and he challenges the group to devise a new SOC that reflects these realities. Thomas Plewes provides an overview of the SOC revision effort to this date, emphasizing why the United States needs to develop a new SOC. Jack Triplett outlines a parallel revision effort, that of the U.S. Standard Industrial Classification System, in an attempt to distill lessons for the occupational classification revision process.

William G. Barron

Acting Commissioner
Bureau of Labor Statisitics

On behalf of the Bureau of Labor Statistics and the many BLS staffers who worked so hard to organize and present this conference, I want to welcome you to the Bureau and our new conference facility. This is the first major international conference we've hosted in our new conference center. So it's a particular challenge for us.

Our goal is to make you feel welcome and comfortable, and to facilitate the kind of thoughtful learning experience that we need to have in order to consider this important topic.

In starting this conference, we have an unprecedented opportunity to reconsider some important aspects of occupational classification: Unifying different structures; meeting the needs of users; reflecting changes in the economy and the organization of work; capturing lessons learned internationally. These are the subjects that we will focus on this week, and each of these subjects has important ramifications.

In the United States, without a centralized statistical system such as that which exists in many of your countries, various Federal agencies historically have developed their own separate occupational classification systems. The systems were designed to meet particular user needs and to meet particular data collection structures.

Although some agencies may prefer to continue maintaining these various incompatible classification systems, others feel that there would be a net value added that could be provided to users of occupational data by developing a more unified Federal classification structure.

As a first step, we need to have a more unified Department of Labor occupational classification structure. Movement in this direction has already started. In its final report, the Secretary of Labor's Advisory Panel on the Dictionary of Occupational Titles recommended that a revised *Dictionary* conform to the classification structure of a revised standard occupational classification (SOC) system, and in the interim conform to the Bureau of Labor Statistics Occupational Employment Statistics system.

The Employment and Training Administration's standard participant information record system, being developed for use in assessment of Job Training and Partnership Act outcomes, also is using the Occupational Employment Statistics system as the basis for reporting occupational placement.

Another source of dissatisfaction lies with the perceived accuracy of current occupational classification structures. Some structures, including the SOC, have not been updated for more than a decade and, therefore, many new occupations that have emerged as a result of new technology or changed forms of work organization are not included in the current classification structures.

Changes in economic structure, in technology, in flexible management strategies, and in work organization itself challenge us to develop and maintain a comprehensive, current and consistent national occupational classification system.

Currently, all Federal occupational classification systems are based on work performed or on job titles. As the pace of occupational change has increased, many people are increasingly concerned with issues of skill transferability between jobs or occupations, in order to facilitate transitions in an increasingly volatile economic environment.

An important issue that will be raised during this conference is whether a new United States standard occupational classification system should be based primarily on skill type, rather than work performed.

Finally, we have seen many innovations in international occupational classifications. We hope that they can be used to inform and educate the U.S. effort, and perhaps vice versa. A full day of the conference will be devoted to international occupational classification issues.

The international experience is important for two reasons. One relates to the international comparability of data, and the other relates to lessons that can be learned from the experience of other countries.

So these are the important reasons for the Bureau of Labor Statistics to have sponsored this conference under the auspices of the Office of Management and Budget, which does have the ultimate responsibility for the United States Standard Occupational Classification system.

In that respect, I would like to introduce Katherine Wallman, the Chief Statistician from the Office of Management and Budget, who will be with us for much of the next 3 days. Kathy, as always, we're pleased to have you here.

About a year ago, when we began the work planning this conference and then formally announcing it, I can assure you that neither I, nor anyone else in the Bureau of Labor Statistics, realized that just 12 months later I would be standing here before you introducing a Secretary of Labor who has published works and writings on the subject of economic change across nations and in our workplaces, which have included a special focus on classification structures and their uses and limitations.

I can assure you I had no idea that I would have such a person to introduce to you today. And, of course, I'm very glad that I do.

If you'll look at the Secretary's work, it's very clear that even beyond technical issues concerning the economy, he has—at least in my opinion—a view of the future.

Clearly, I can't do justice to the career this man has had, both in the public and private sector before becoming Secretary of Labor, and the contributions he has made to the Government and to the Department in the short time that he has been Secretary. I can't do justice to that in this brief amount of time, and I don't think anyone could.

But, there are a couple clear messages that I would like to leave with you today. The fact that he is here, interrupting what I think is a brutally demanding schedule, is an indication of the importance that he attaches to the work of this conference and to your work.

In a broader context, I think it's a very clear sign of the commitment and the esteem that he has for the work of data producers generally. Robert Reich is a hands-on data user. He has a tremendous respect for the agencies and the institutions that produce such information.

In these difficult budget times, it wouldn't be responsible for me to indicate to you that either he nor I could resolve all the difficult budget dilemmas that we may face. But there is one thing that is very clear. BLS has a Secretary who has a deep and abiding commitment to this institution, its work, and its people. I'm very proud to introduce to you the Secretary of Labor, Robert Reich.

Robert B. Reich

U.S. Secretary of Labor

Good afternoon. It's so nice being in front of a group of adults. For 12 years, I would say, "Good afternoon" to students and they'd write down "Good afternoon."

First of all, the reason I'm here today is, not only to encourage you, but because I believe that good public policy depends on good data. You cannot make good public policy if you don't have good data. That is the starting place for good public policy.

And, with regard to the work force, good public policy depends on good data about the work force. I suppose I have a certain prejudice because of my academic background, but I can also tell you that in countless ways the work you are doing internationally for the BLS, the work from OMB—I can see many of you from different parts of this Government—you are affecting public policies in ways you can't even imagine and are having a very profound effect on public policy.

Now, it's becoming even more profound because the structural changes that are occurring in the work force—both domestic and international—have become political in the sense that they have political consequences.

In just a few weeks, the United States is going to announce the first of its base closures—major sets of base closures. That is the beginning of an escalation of a military build-down, as they say in bureaucratese. I never quite understood what a build-down was until I came to the Government.

There are, therefore, endogenous factors. There are things that the United States Government is doing here that are affecting the structure of the U.S. economy. But, there are also all sorts of exogenous factors that are occurring. Large companies are slimming down, largely because of technology and international competition. Small companies are popping up, again, in part because of technology and international competition.

We see in advanced, industrial countries a certain pattern, indicating that if you have wage rigidities built into your system—rigidities in terms of setting national wage rates, or any kind of national wage structural processes—the result often has been structural unemployment rates higher than in countries such as Britain and the United States where the wage structure is more flexible.

But, those can't be the two alternatives. That's a Hobbesian choice. If our choice is either a flexible wage structure, in which an awful lot of Americans are basically getting poorer in terms of their wages, benefits and working conditions, or a less flexible wage structure in which we have much higher levels of structural unemployment, then industrialized nations are all in trouble. There's got to be a third choice.

As the demand for higher skilled workers shifts in favor of people with education and training, and against people who do not have education and training, the third option becomes very clear—ensuring that your work force is adequately prepared.

In this country, there's been a big debate over the last 10 years about whether the middle class is, indeed, shrinking, and as one of those academics who supported the claim that the wage structure was polarizing, I remember having endless discussions with people here at BLS, particularly Janet Norwood, who is one of my dearest friends. Janet and I would be debating all the time, and the data were very indecisive. The data are still not completely free from controversy, but I think that there is more consensus now that there is a polarization going on, which has to do with international trade and technology. Without international trade, we'd all be in worse shape, because international trade tends to reward people who are the problem solvers, who are well educated in advanced industrial countries and who, therefore, have a larger market for their problem-solving abilities.

By the same token, as you open markets all around the world, there are 12,000 people entering the global economy every hour, the vast majority of whom would be delighted to work for a small fraction of unskilled American wages.

Technology has the same bifurcating effect, I think, with regard to skilled people. Technology is a tool, a computer, some piece of information technology, some piece of high-tech machinery, that helps enlarge problem-solving capacities.

All of you in this room are problem solvers; you are problem identifiers, using technology like mad. Technology is adding to the value that you, in turn, add to this and the global economy.

On the other hand, if you don't have skills, technology tends to supplant you or push your wages down if there is a good deal of wage flexibility.

We used to have a lot of telephone operators in this country before automated switching equipment came along. And I'm talking about the service sector, not just the manufacturing sector. That's what everybody focuses on, robots in the factories, computer-aided design, computer-aided manufacturing, computer-integrated manufacturing; it's not just the factory sector.

I am not one of those who believes that the central problem in industrialized nations as well as the country

is a loss of manufacturing jobs, because it depends on where those jobs show up on the national income accounts. Design engineers, manufacturing engineers, a lot of marketing and advertising specialists, and a lot of high-value-added jobs are on the service side of the national service accounts if they are out-sourced, and that is what is happening.

The value of any product these days comes from the business services, design engineering, manufacturing engineering, marketing, advertising, investment banking, sad to say, legal services, the actual service, the actual manufacturing.

We need your help. Let me say that once again. We need your help. We, who have policymaking responsibilities, not only in the Administration, not only in the Executive Branch, but also in Congress, we need your help in terms of understanding these structural shifts in the economy.

There is a great need out there, and it's expressed every day. In fact, this morning I was up with a group of legislators, the heads of a bunch of committees, and we were talking about jobs.

There was Dan Rostenkowski, Ways and Means, and Dick Gephardt, the Majority Leader of the House, and several other committee heads around a table, and the topic was jobs, and the question was, what are we going to do? The structural unemployment seems to have increased during this last recession. It looks like more of the victims of net new job losses are not going to get their jobs back. And, if on top of that we have military down-sizing, and on top of that we have NAFTA, and on top of that we have changes in the health care system, there are going to be costly, huge shifts with regard to jobs. Does it mean fewer clerical jobs, in terms of insurance companies? Does it mean more jobs in terms of home health care? All of these committee heads sitting around a table—we have to understand the job structural situation. We've got to come up with policies. Our constituents are hurting. They are in anxiety out there.

Now, I could give them some data, some of the data that many of you in this room had come up with, but the question is, can we do better for policymakers given these structural shifts?

I think the answer has to be yes, because the issues are becoming more and more difficult and problematic.

We do need a uniform system across the government with regard to these job classifications. I don't know how we are going to get there, but it just doesn't make sense to have all kinds of different ways of classifying jobs.

Now, with regard to skills, we also have to explore the possibility, not only with regard to occupational classifications, but also skill classifications. We need to know more about where the skills are and what people need to be trained for. I don't know quite how we are going to be doing that. These are big, big issues, big, big problems, but I can assure you that unless we get some handle on these issues—of uniformity and comprehensiveness with regard to job titles, occupational titles, the structure of those occupations, and also some sense of where the skills are and where they are needed, or where they are, or what occupations incorporate what kinds of skills—it's going to be harder and harder to make the kinds of policy decisions that are increasingly being demanded of policymakers, and that's the point I want to get across.

The demand side of this equation is increasing. Now, you might say to yourself, "If the demand is increasing so much, where are the resources?" And, as somebody who has been in this job only 5 months and considers himself a non-professional bureaucrat, administrator, and non-professional politician, I am still mystified by how decisions are made about resources, even though I sat there for 3 months at a table in the Roosevelt Room in the White House trying to help the President make decisions on the economic plan. I am still mystified as to how we got where we are right now with regard to the resource needs of the Government, but that is another story for another day.

Let me simply say that we have to live within the constraints. If you were a group of people in the private sector, perhaps in a major successful private-sector corporation, I dare say that you would be facing the same resource constraints and feeling the same sense of frustration of being expected to do more with fewer resources.

I used to do some consulting for the private sector, and every time I visited successful companies, I would hear exactly the same complaint: How in the world are we going to do it? Our resources are being slimmed down, we have greater and greater constraints, more and more demands on us. Yes, it makes sense to do what they say we want to do, but how can we possibly do it?

So, this is not just the Federal Government, this is society-wide, and I dare say it's exactly the same in other countries as well.

We all have to do better with less, in both the public and private sectors.

I just want to get across to you that the only way the public sector in this country is going to do better with less—particularly, with regard to jobs in the work force, which, after all, are the centerpieces of the Clinton Administration's agenda—is to get better information. And, I realize this is not going to happen overnight: this is a long process, but I feel so strongly about the importance of this process.

You know, I have an odd fascination with job classifications, and I can't tell you when it began, but I can tell you one of the sources of the fascination is that if you look at the history in this country of how jobs have been classified, you actually have a sort of

anthropological/sociological view of how society has viewed itself.

Job classifications reflect value judgments about the structure of an economy and jobs, and we have evolved over time. Now, unfortunately, often in periods of history our evolution is a little bit behind where things are, but these have evolved over time, and they respond to society's sense of itself—not only where it is, but also where it wants to be.

We never thought in terms of blue collar and white collar before the 1930's. But in the 1930's, there was a book which first established the notion that there were blue-collar and white-collar jobs—two distinct classes of jobs in America. As a result, job classifications began to evolve.

In any event, let me personally thank you from the Administration and also from the Department of Labor for the efforts that you are making, for the efforts that you are going to be making, and let me express my support for the importance of the effort you are undertaking, and God speed you all.

Thank you.

Why Redo the Standard Occupational Classification System?

Thomas J. Plewes
Bureau of Labor Statistics

My purpose here today is to set the stage for the conference, to help define its purpose, and to justify its convention. I undertake that small order in concert with Jack Triplett of the U.S. Department of Commerce's Bureau of Economic Analysis, who chairs the intensive U.S. Government effort to refine all economic classification systems.

The setting for conferences which enlist the interest of a distinguished group of participants, excite the intellectual curiosity of a group of superb writers and speakers, and elicit the support of such organizations as the Employment and Training Administration (ETA) of the U.S. Department of Labor and the Bureau of the Census is set long before the welcoming remarks are made. Such conferences begin with a *need*, are borne of a *vision*, and are the product of much *hard work*.

The need is obvious. I will discuss that at some length. Other speakers will dwell on that more elequently later in the proceedings.

The vision is a shared vision. It is a vision of the Office of Management and Budget, which under Hermann Habermann and now Kathy Wallman has been able to parlay a sparce resource base into major reconsiderations of economic and geographic classification structures, as well as serious review of program issues. We also want to acknowledge the contribution of Paul Bugg, who has been a driving and inspirational force in this process.

I'm going to stop naming names quickly, for fear that I'll omit an important contribution. I do want to acknowledge the vision that Dixie Sommers, chair of the Advisory Panel for the Dictionary of Occupational Titles (APDOT), and the leadership that Carolyn Golding, Bob Schaerfl, Bob Litman, and Donna Dye of ETA brought to the process. All of us had convinced each other some time ago that a revamping of the *Dictionary of Occupational Titles* (DOT) needed to be accompanied by a revamping of the SOC, and, that at the end of the process, they needed to be compatable. ETA put its money where its vision was, and sponsored several of the papers that we will hear this week.

Finally, there is the Bureau of Labor Statistics (BLS) staff. A group of dedicated economists and statisticians headed by Brian MacDonald and Mike McElroy who have worked so hard to organize and present this conference. This is the first major international conference we have hosted in this new conference center, so it is a particular challenge for us. Our goal is to make you feel welcome and comfortable, and to facilitate the kind of thoughtful, learning experience we need to consider this important topic.

So, why are we here? At the beginning of 1991, when we began to seriously consider the need for a revision of the SOC, here was the status of the major occupational classification systems:

Historically, various United States Federal agencies, primarily the U.S. Department of Labor and the Bureau of the Census, have developed their own separate occupational classification systems, designed to meet their own specific statistical and programmatic needs. The lack of comparability between these various sources of occupational information and data led to multi-agency interest in and action to develop a Standard Occupational Classification (SOC) system, beginning in 1966.

The SOC was first published in 1977 and revised once, in 1980. It was intended to provide a mechanism for cross-referencing occupation-related data collected by various economic and social statistics programs in order to maximize the analytical utility of these data.

Unfortunately, the SOC never was fully implemented across all Federal occupation-related data collection efforts. In addition, the 1980 version of the SOC is outdated, as new occupations—particularly in technical and health-related fields—have emerged since that time (and are incorporated into some of the current occupational classification structures).

We were sensitive to recent concerns with the quality of the U.S. workforce, skill formation issues, and changes in occupational structures due to new technology and shifts to "high-performance" work organizations. They highlight the importance of accurate, timely, and comparable occupational information to support program planning, career guidance, and training development.

In 1991, we joined with many users and producers of occupational data who felt that it is time to reexamine the SOC and to develop a classification structure that meets the occupational information needs of the twenty-first century:

In November 1991, the Office of Management and Budget designated the U.S. Department of Labor as the lead agency to coordinate the development of a new

United States Standard Occupational Classification system by 1997. Since that time, the Bureau of Labor Statistics' Office of Employment and Unemployment Statistics and the *Dictionary of Occupational Titles* staff of the Employment and Training Administration have been working together to organize activities aimed at developing information and alternative approaches related to classification principles for the new SOC. These activities have included commissioning contract papers on major occupational classification issues and soliciting contributions of papers on other specific topics.

In BLS, we understand the new Deming-Joran-Crosby science of Total Quality Management. The first tenant is to understand your customers. Who are the customers of occupational classification?

We have not advanced much from where we were in 1991, but there are some important building blocks in place.

Most importantly, we come to you with a focus based on a similar experience which the Bureau of the Census established in the case of the industrial classification issues.

Though we have a foundation in the work of APDOT and the use of the systems we have developed, and though we have a process road map that Jack Triplett will discuss in more depth shortly, we must look to the future as we think about where we should go with occupational classification. This is the future as we see it. The uses of occupational information are expanding exponentially.

What should our goal be in the U.S.? Here is a simple depiction of an integrated system.

The summation of the vision for the time frame which OMB has challenged us to make changes is presented here, not as a hard-and-fast goal, but as a starting point for this investigation.

How do we achieve that vision? It is quite simple. The process starts with this conference. But having such expectations brings challenges.

We hope that this conference will provide a forum for discussion of new ideas and alternative approaches to occupational classification issues. The contracted and invited papers will be presented at the conference. We see this process as paralleling recent efforts, initiated by the Bureau of the Census and coordinated by the Bureau of Economic Analysis related to the revision of the Standard Industrial Classification (SIC) system. These initial papers and conference discussions will serve to kick off revision activities for the SOC. The Conference will include many of those persons and agencies directly involved with the user community of occupational classifications.

Following the conference and drawing upon its findings, we expect that a revision committee, composed of representative Federal agencies in coordination with international bodies, will be assembled by the Office of Management and Budget to manage the SOC revision.

The SOC revision effort is a multi-lateral one, as is illustrated by the diversity of the Conference attendees. As you look around, you will see conference participants who represent a variety of organizations and individuals who are involved with either development or use of occupational classification systems or occupational information.

International experts on occupational classification from the following countries are participating: Australia, Canada, France, Mexico, The Netherlands, Poland, Sweden, and the United Kingdom. The key architect of the International Standard Classification of Occupations for the European Community also is here.

Representatives of Federal agencies that develop and/or use occupational classification are participating. Representatives from the relevant Federal agencies which are likely to be part of the technical committee that OMB assembles to actually carry out the revision work after the conference are here. The key Federal players include the Department of Labor's Bureau of Labor Statistics and the Employment and Training Administration, the Department of Commerce's Bureau of the Census, and the Office of Management and Budget's Office of Statistical Policy.

State-level agencies and coalitions of related state bodies that develop and/or use occupational information and classification systems are here. These include the Interstate Conference of Employment Security Agencies, the National Governors' Association, the National and State Occupational Information Coordinating Committees, state alien certification offices, and others.

Nongovernmental organizations that have an interest in occupational classification issues are in attendance. We have included representatives from business, labor, private associations, and consultants.

This is a solid mix of people and agencies, and from this mix, we expect nothing less than greatness!

Economic Concepts for Economic Classifications

Jack E. Triplett [1]
Bureau of Economic Analysis

The United States, in cooperation with Canada, has begun a far-reaching examination of the economic concepts that underlie economic classification systems. The first public output of this project is the publication, in the U.S. *Federal Register*, of two "issues papers," which request public comment on a series of conceptual questions concerning economic classifications.[2] These two issues papers have been made available for review at this conference.

The present paper summarizes the background that preceded the U.S. investigation and progress so far.

Background

The U.S. Standard Industrial Classification (SIC) system was developed in the 1930's and early 1940's. The SIC system has been used by statistical agencies in the United States to ensure comparability in industrial definitions and classifications across industrial surveys. It has been revised periodically, the last time in 1987, with the intention of keeping the system abreast of changes in the economy.[3] The SIC system is, therefore, well developed, it is well tested in the sense that it has been employed in the production of economic statistics over many years, and it has frequently been reviewed.

Nevertheless, the U.S. SIC has been subjected to strong and increasing criticisms. No doubt some of these criticisms contain hyperbole. But it is no exaggeration to say that criticisms of the SIC are widely accepted and are shared by many users of data produced by the U.S. classification system. Because the criticisms have appeared in public discussion and articles in the press, attention to economic classifications in the United States has been extended well beyond the usual technical discussions of economic statisticians.

In response to user concerns about the SIC, the U.S. Census Bureau sponsored the International Conference on the Classification of Economic Activities in Williamsburg, Virginia, in 1991 (hereafter, "Williamsburg Conference"). The Williamsburg Conference contained extensive discussions of the economic classification systems that will be needed for the 21st century. The Executive Summary of the Williamsburg Conference notes: "Many participants urged a 'clean sheet' approach to developing a new classification system, based on a conceptual framework." This call for a conceptual framework for classification systems represents a relatively new strand in thinking about economic classifications.

In response to user dissatisfaction with the U.S. SIC and to the Williamsburg Conference proposals for rethinking the conceptual basis for classifications, the U.S. Office of Management and Budget established, in 1992, the Economic Classification Policy Committee (ECPC). The ECPC is charged with a "fresh slate" examination of classification systems, with particular emphasis on their conceptual foundations. The ECPC is also emphasizing classifications that will: (a) improve services data, and (b) improve the international comparability of industrial statistics.

The ECPC has joined with Statistics Canada to form a working group to study conceptual issues in economic classifications. Research is underway to determine how the U.S. and Canadian industrial classification systems mesh or do not mesh with the economic concepts discussed in ECPC Issues Paper No. 1. The two countries are working to design classification systems that will improve the data for the purposes for which industrial statistics are gathered and that will also increase comparability between industrial statistics in the United States and Canada. Representatives from the Instituto Nacional de Estadística, Geografía e Informática of Mexico are also participating in the series of North American meetings conducted in 1992–93.

As noted above, the ECPC's initial two issues papers review and discuss conceptual issues underlying economic classifications. Other issues papers (listed in the Introduction to the first two issues papers) are being prepared and will be available on request. The remainder of this paper summarizes the principal issues the ECPC is addressing and the initial responses of users who have reviewed the ECPC issues papers.

The Conceptual Issues

One of the ECPC's major tasks is the development of an underlying economic concept for economic classifications. When applied to industrial statistics, this search for an economic concept implies the return to an old question: What do we mean by the term "industry?"

The ECPC has approached the answer to the industry definition question by posing a more fundamental question: "For what uses are industrial statistics wanted?"

When one has specified a use of economic statistics, one can then derive an underlying classification concept from the use of the data. If the classification concept is implemented consistently throughout the system, the data will be appropriate for the intended use.

The ECPC's approach to the question of industry definition marks perhaps its greatest departure from past work on classifications.

Obviously, there are multiple uses for industrial statistics. The ECPC's analysis suggests that the multiplicity of uses of industrial statistics can be divided into two broad categories, which implies two alternative economic concepts for classifications.[4]

Uses that imply a production-oriented concept

For some uses, grouping by similarity of production processes will provide the appropriate industrial statistics. Examples of such uses include the measurement and analysis of productivity at the industry or sector level, comparisons of the capital intensity of production across different economies, or marketing analysis for products or services that are inputs to particular production processes. In the ECPC issues papers, the economic concept that is appropriate for such uses of industrial statistics is designated a "production-oriented" or "supply-based" concept. In international materials on classifications, this production-oriented economic concept is similar to the definition of the term "activity."[5]

Uses that imply a demand-side concept

For other uses, grouping according to characteristics of the demand for commodities will provide the appropriate industrial statistics. Examples of such uses of industrial data include calculating market share for studies of monopoly power, or marketing analyses that are concerned with competitive shares, or demand studies, either demand for consumption goods or demand for inputs to other production or distribution processes. For these uses, one groups commodities by similarities in the way commodities are used, close substitutes, for example, or commodities that are used together. This second concept for economic classifications has been designated in ECPC papers as a "use of the commodity," or "market-oriented," or "demand-based" concept.

It is not difficult to find examples where the two broad principles or economic concepts conflict in application. The ECPC issues papers discuss the case of sugar products, which in the United States are divided into three separate industries on the basis of production differences (raw material and processing, and degree of vertical integration). Separating sugar products on the basis of production differences might be appropriate for the analysis of production, productivity, and so forth, and so might be consistent with a production-oriented concept.

The U.S. groupings of sugar products, however, certainly do not correspond to a market- or demand-based grouping: For most uses of sugar products, a cane sugar product and a corresponding beet sugar product are probably perfect substitutes. Present U.S. sugar industry groupings seem inappropriate for studying competitive market share or for demand analysis. Indeed, for many market-oriented purposes, the appropriate category is not sugar products at all, but rather "sweeteners." One would group sugar products with corn sweeteners (now placed in an industry defined in the United States on the basis of production process), with honey, and with artificial sweeteners (located in the U.S. SIC in an inorganic chemicals industry).

In contrast to the sugar products example, some other U.S. industries group together producing units that have very different production processes. Examples noted in ECPC issues papers include "Hand and Edge Tools" (which appears to be grouped partly according to commonality in distribution systems) and "Musical Instruments." From a grouping containing such heterogeneous production processes, it is not clear that one could learn anything useful about production relationships, about differences in capital intensity across different economies, or about marketing of inputs.

The same distinction between "production-oriented" and "demand-based" concepts appears in comparisons of international classification systems. For example, the United States distinguishes fishing by production methods—fish farming is placed in a different SIC from catching fish in the open sea. Canada, on the other hand, uses a demand-based, marketing concept: Salmon caught in the ocean or produced on fish farms are very close substitutes from the view of the consumer, and they are distributed in similar ways, so they are grouped together.

The production-oriented and demand-based distinction can be seen again in the work underway to form a concordance between Canadian, U.S., and NACE classification systems: Of the cases on which the three countries' statistical agencies cannot agree in interpreting ISIC, one or more of the three has implemented a production-oriented concept and another has adopted a demand-based concept. For example, the United States places "wood chips" in different industries because different production processes are used (this decision corresponds to the ECPC's production-oriented classification concept). Eurostat, in NACE, groups all wood chips together because the chips serve the same purposes (thus implementing what the ECPC calls a demand-based or market-oriented concept). Other similar, and enlightening, examples have come out of the concordance project.

Thus, whether comparing industrial classifications within one country's system or comparing classifications across the system used in different countries, one encounters the same phenomenon. Some classification decisions have been based on production-oriented reasoning. Others have been erected on market- or demand-based reasoning. In some cases, decisions involving market- or demand-

based reasoning have been superimposed on a basic structure erected on production-oriented reasoning.

The observation that demand-based and production-oriented considerations exist in the definition of industry is not itself new. James McKie noted that: "Marshallian economics envisioned a structure of single-stage industries producing single products. For analytical purposes, the boundary of the industry is still usually *assumed* to be the same as the boundary of the market. . . . But such a concept is too simple to serve as a framework for statistical reporting" (emphasis supplied).[6]

Despite this recognition, the objective pursued in designing nearly all classification systems, including that of the United States, has been to try to find the "perfect industry" in which the production-oriented concept and the demand-based concept agree. Implicit in this attempt is the notion that cases where the two concepts do not agree and do not yield the same classification are exceptions to the general rule, and exceptions can be handled on a case-by-case basis. Alternatively, when the exceptions are found, one believes that some compromise between the two conceptual bases for classification will produce statistical measures that can accommodate both of the two broad categories of users.

The ECPC's investigation suggests that in a modern industrial economy, the perfect industry, the one where production-oriented and demand-based concepts coincide, is by no means the norm. In many instances, production-oriented and demand-based concepts yield quite different classifications. Those latter cases are too pervasive to be thought of as mere exceptions.

The United States and Canada have two studies underway that examine 4-digit SIC industries in the respective countries, to determine the extent to which industries now reflect primarily demand-based or production-oriented economic concepts. A very preliminary result, based on Canadian 4-digit SIC industries, suggests that roughly one-third of the industries appear to incorporate a demand-based or market-oriented concept, one-third of them appear consistent with a production-oriented concept, and the other third constitute "perfect" industries, in which demand-based and production-oriented concepts are both incorporated. Both the Canadian and the U.S. studies will be available soon.

ECPC Decisions

Major decisions to be faced by the ECPC include resolution of the following three questions.

Is a consistent concept for economic classification desirable?

The case in favor of a consistent economic concept is set out in ECPC Issues Paper No. 1 (section 1.4), which lists the following points:

- Without a consistent economic concept for grouping and classifying data, users will find that the data are not always grouped appropriately for a given purpose. Inconsistencies arise in the system and users may not know where they are. Where users do see inconsistencies, it leads to criticism of the system and the complaint, which has frequently been expressed, that data grouped by SIC's are not useful for analytic purposes.
- Equally important, without a consistent economic concept, whoever constructs a classification system must inevitably choose from among competing requirements. A consistent economic concept provides an overall philosophy that can be incorporated into the description of the system and can guide decision making during the process of constructing the system.
- In presenting the classification system to the public, an economic concept facilitates explaining why data are grouped in one way rather than in another. Without a consistent concept, without some overall philosophical preface, the system as a whole cannot be understood by users. When users do not understand the system, this leads to inadvertent misuse of the data, and also to controversies and criticisms of the system that arise from misunderstanding of its purpose. The system needs a consistent concept to provide a coherent framework for critiquing the system in order to improve it.

The counter argument, the position opposing the use of a consistent economic concept in a classification system, is also expressed in ECPC Issues Paper No. 1, at least as that position has been stated in the United States. The following points have been made.

- A consistent economic concept may not be feasible in a classification system because industries themselves are organized in differing ways. Some industries are organized on the basis of production relations, but others are organized on the basis of marketing patterns or uses. The present system reflects those differences.
- Those who criticize the SIC system because it contains inconsistencies of concept do not understand that these apparent inconsistencies exist because of variations that exist in the economy. Inconsistency is valid criticism of the classification system only if consistency is the major objective of the system.
- In some cases, it seems doubtful that data can in fact be collected on one or the other of the conceptually-based systems. On this view, then, a conceptually-based system is not practical.

A major task of the ECPC is to sort out and resolve these conflicting positions.

Are multiple classification systems feasible or desirable?

Review of the uses of industrial data suggests that at least two different conceptual bases are wanted in classification systems. If the ECPC were to propose a classification system based on an economic concept, this implies the necessity for two, or possibly more, classification systems. If multiple classification systems are put into place, there may be problems with cost, possibly with confidentiality, and potential confusion may be created among users.

Is the implementation of a consistent economic concept in a classification system feasible?

The proposal for implementing a consistent conceptual basis for economic classifications needs to be tested and this has yet to occur. The ECPC has noted a number of recent research studies that have developed new techniques, based on economic theory, to distinguish production-oriented groupings and demand-based economic aggregations. Though these techniques hold promise, they may not be fully operational in time to make a real contribution to imminent classification decisions. Moreover, they may point toward new data requirements beyond what already exist for constructing classification systems. The ECPC has studies underway on statistical and other methods for distinguishing industries, and also on collectibility questions that limit what can be done in economic classifications.

Reactions So Far From Users

ECPC Issues Papers Nos. 1 and 2 have been published for only a relative short time, and a full range of public input has not yet been received. The papers have been presented to statistical agency advisory committees of the U.S. Bureau of the Census and the U.S. Bureau of Labor Statistics.

The Census Bureau advisory committees represented the American Economic Association, the American Marketing Association, and the American Statistical Association. Comments received from all three organizations were highly favorable. Representatives stated that the issues the ECPC were exploring were important issues, that they had not been fully explored before, and they believed that the issues should be explored by the ECPC. The representative from the American Marketing Association indicated that, though the concepts in the ECPC issues papers have been drawn from economics, it is useful in marketing, also, to distinguish production-oriented and demand-based analyses that make use of industrial data.

The ECPC also met with the Business Research Advisory Committee to the Bureau of Labor Statistics. These business representatives indicated that some parts of the present U.S. SIC were quite satisfactory for their purposes, but others were not. They were less certain that the ECPC's distinction between production-oriented and demand-based concepts was relevant for the mostly pragmatic concerns that they expressed.

The ECPC plans to meet with other agency advisory committees, and has an extensive public outreach program in the planning stage. Comparable discussions will be held with Canadian users of industrial statistics.

Future Plans

The United States wishes to continue to share the ECPC's research and deliberations on classifications as the work proceeds over the next several years. The ECPC appreciates comments from the international statistical community on its approach, on the issues that it presents in its issues papers, and on its research studies as they become available. The ECPC welcomes the opportunity for international dialogue on concepts for economic classifications, in this forum and in others as well.

Notes

[1] The author is Chief Economist, U. S. Bureau of Economic Analysis, and Chairman, Economic Classification Policy Committee.

[2] Issues Paper No. 1, "Conceptual Issues," and Issues Paper No. 2, "Aggregation Structures and Hierarchies."

[3] U.S., Executive Office of the President, Office of Management and Budget, *Standard Industrial Classification Manual, 1987*, 705 pages. (For sale by: National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161. Order Number PB 87-100012.)

[4] The two concepts are summarized in section 1.2 of ECPC Issues Paper No. 1, "Conceptual Issues," and in a somewhat more technical treatment in Jack E. Triplett, "The Theory of Industrial and Occupational Classifications and Related Phenomena," *Proceedings*, Bureau of the Census 1990 Annual Research Conference, March 18–21, 1990, Arlington, Virginia: U.S. Department of Commerce, pp. 9–25.

[5] United Nations, "International Standard Industrial Classification of all Economic Activities," Statistical Papers, Series M, No. 4, Rev. 3, New York: Statistical Office of the United Nations, 1990, p. 9, par. 29.

[6] McKie, James W., "Industry Classification and Sector Measures of Industrial Production," Bureau of the Census Working Paper No. 20, Washington, DC: U.S. Department of Commerce, 1965, 12 pages.

Module 1. Perspectives of Current Occupational Classification Systems

Introduction

Different perspectives on various current U.S. occupational classification systems are presented in the papers in this section. Brian MacDonald and Paul Hadlock describe the development of the current U.S. SOC and the barriers to its full implementation. Raymond Moran overviews the U.S. Office of Personnel Management's (OPM) General Schedule Position classification system, and William Bailey describes the classification structure of BLS industry and area wage programs that flow from the requirements of the OPM structure. The history and structure of the classification used in the decennial census, as well as the Current Population Survey, are described by Thomas Scopp and John Priebe. Michael McElroy provides an overview of BLS's Occupational Employment Statistics (OES) classification system and describes some recent initiatives in the OES establishment-based survey that could provide input to the SOC revision process.

The 1980 Standard Occupational Classification

Brian MacDonald
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Introduction

This paper covers the development of the 1980 Standard Occupational Classification (SOC) system, discusses the purpose of the SOC, provides an explanation of the classification principles underlying the system, describes both the structure and the content of the SOC,[1] and relates how the SOC was implemented.

Background and purpose

Occupational classification in the United States had not been organized by one centralized system until the 1980 Standard Occupational Classification Manual was issued.[2] Various agencies, primarily the Department of Labor and the Bureau of the Census, had designed and engineered their own occupational classification systems to meet their own needs.

The Department of Labor established the Dictionary of Occupational Titles (DOT) to provide a complete detailed picture of all occupations within the economy for job placement, employment counseling, occupational and career guidance, and other labor market information services. The Bureau of Labor Statistics' (BLS) Occupational Employment Statistics (OES) survey was established in the 1970's to produce data concerning the occupational composition of a wide range of industries. This was accomplished by surveying a large sample of employers, and the OES occupational classification was designed from that perspective.

The Bureau of the Census develops and revises their occupational classification system[3] to be used for each Decennial Census of Population and Housing. Their occupational classification system was engineered to be applicable to a household data collection method, used by the decennial census and the Current Population Survey (CPS) to provide a wide range of demographic data concerning workers in the economy.

Looking back to the 1970's, there was very little comparability between these systems. The Bureau of the Census 1970 occupational classification system had 441 occupations; the mid-1970's OES occupational classification more than 1,600; and the DOT, more than 11,000. The BLS Industry-Occupational Matrix[4] uses the occupational employment estimates for industries from the OES survey to develop wage and salary estimates for each occupation. The matrix relies on the Census and CPS data to fill in those areas not covered by the OES survey. Additionally, the demographic information provided by the household sources are used by BLS analysts. It was difficult, however, to effectively assimilate the OES survey data and the household data into one model when the occupational information was grouped using different classification systems.

The 1980 SOC was developed concurrently with the 1980 Census of Population and Housing occupational classification. The Bureau of Labor Statistics also committed itself to revise its OES occupational classification at the conclusion of the SOC development. This began with the 1983 OES survey. The CPS adopted the new 1980 Census occupational classification, also in 1983.

As stated in the SOC Manual, the SOC "provides a mechanism for cross referencing and aggregating occupation-related data collected by social and economic statistical reporting programs. The system is designed to maximize the analytical utility of statistics on labor force, employment, income, and other occupational data collected for a variety of purposes by various agencies of the United States Government, State agencies, professional associations, labor unions, and private research organizations."[5]

The SOC employs a structure designed to be suitable for use in and out of government. Recognizing that data users have different needs, the SOC Manual encourages them to employ a level of detail from the SOC which suits their needs. This built-in flexibility is intended to promote the use of the SOC in comparing and analyzing occupational data from multiple sources.

Principles of classification

The SOC system has 12 principles of classification which form the theoretical basis for determining how the component occupations are categorized. These principles were the result of trying to accommodate the diverse needs of the occupational information user community. When the principles are applied to individual occupations, some come into conflict with others. These conflicts are not unusual in classification systems with multiple principles (such as the U.S. *Standard Industrial Classification* (SIC) *Manual* which has 3 principles), but occur particularly often in a system with 12 principles. An example of such a conflict in the SOC will be cov-

ered in the explanation of the third classification principle contained below.

Following is an explanation of the SOC's 12 principles of classification. (A list of the principles is contained in table A.)

The first principle of the SOC is that it reflects the current occupational structure of the United States. While this may seem to be obvious, the determination as to what is an accurate reflection of the occupational structure is not so obvious. One might argue that many of the remaining principles seek to define this reflection of the structure of occupations in the economy. The inclusion of the word "current" in this principle implies that the SOC was meant to be a living document.

The second principle prescribes "work performed" as the basis for classifying occupations. This results in such classification decisions as placing sales engineers (code 421) within the sales division rather than with other engineering occupations because the nature of the work performed is sales.

The third principle of considering place of work (industry) can create a conflict with the "work performed" principle. While nursery managers may perform the same managerial duties as managers in other industries, they are classified in the Agricultural Division within the SOC (code 5525).

This principle of industry consideration also is adhered to when dealing with private household occupations. Private household cleaners, cooks, and child-care workers (codes 502–507) are classified separately from similar service occupations which are performed by employees of establishments.

The fourth SOC classification principle deals with placing occupations in like (homogeneous) groupings. This focuses on the similarity of the work performed (principle 2) in order to create distinct occupations that are neither too large nor too small. (See principles 7 and 8.) An example of a well delineated homogeneous SOC occupation is solderers and brazers (code 7717). This occupation has six DOT codes assigned to it in the *Manual,* five of which are in the welding industry and the other (solderer, barrel ribs) in firearms manufacturing. The next occupation listed in the SOC is assemblers (code 772). This occupation includes over 500 DOT titles assigned to it in the manual from over 50 different industries.

The fifth principle concerns classifying occupations based upon the primary activity performed or which activity the worker spends most of his time doing. This principle is difficult to implement in the many cases where a worker does so many different things that it is difficult to determine which activity is the primary one. In the clerical area, the SOC dealt with multiple duties by creating the minor group general office occupations (code 463).

The sixth SOC classification principle concerns assigning occupations at the lowest level of classification. In the SOC, the lowest level of classification is always a distinct 4-digit code. Where a 2- or 3-digit code in the structure has no more detailed components, one adds zeros to create the 4-digit codes.

If there is not enough detailed information concerning an occupation to assign a code at the 4-digit level, one must settle for assigning the code at the next lowest level for which an accurate code can be applied. For example, if in a household survey a respondent reports that he or she is a university teacher, one cannot code in any more detail than the major group teachers; college, university, and other postsecondary institution (code 22).

The seventh and eighth principles of classification negate using employment size as the sole reason for including or excluding an occupational group. These principles contrast sharply with the SIC system which has employment size as one of its three principles. The SOC principles afford the system the flexibility to count employment size but not weigh it so heavily that one would have to be updating the system every time an occupation lost or gained employment relative to other occupations.

The ninth principle requires the identification of supervisors separately from workers they supervise. Within the SOC, this principle is generally followed except in the professional and technical divisions which do not separately identify supervisors. For example, a supervisor of chemical engineers would also be classified as a chemical engineer (code 1626).

The tenth principle places apprentices and trainees in the occupations for which they are being trained while the eleventh principle states that helpers are identified separately from those they are helping. The rationale for the different approach between apprentices and trainees versus helpers is that apprentices and trainees are expected to advance to the positions they are studying, while helpers are not in line to learn and achieve the skills necessary to enter into the trade which they are helping. This departs from the work performed principle somewhat because the helper and trainee will often be performing the same job functions.

The last SOC principle of classification stated that secondary consideration was given to comparability with the International Standard Classification of Occupations (ISCO).[6] This was certainly true with the 1980 SOC. Although the 1968 version of ISCO (the version in place in 1980) was not a foundation for the creation of the SOC, these two classifications did have many similarities.

Structure

The SOC has a four-level hierarchy to facilitate aggregation and disaggregation of data and consists of: Division; major group; minor group; and unit group. Table B illustrates the number of occupations in each of these levels broken out by selected occupational categories.

In the 1980 SOC, there are frequent instances when the lowest level of the classification does not equate

with the unit group. Many minor groups (3-digit level) do not contain further unit group occupational detail. Also, there are instances when major groups have neither minor nor unit group detail. Examples of major groups which stand alone as the lowest level of detail include:

SOC code	Title
24	Vocational and educational counselors
27	Veterinarians
29	Registered nurses
34	Athletes and related workers
60	Supervisors; mechanics and repairers
67	Supervisors; precision production occupations
71	Supervisors; production occupations
85	Supervisors; handlers, equipment cleaners, helpers, and laborers

Content

The SOC covers all occupations in the economy for which work is performed for pay. There are 664 detailed occupations in the system. Among these are numerous residual or "all other" occupations which are used to ensure complete coverage of all occupations. Table C shows the number of detailed occupations in selected occupational groupings.

Each occupation consists of a title, a description of the duties involved, and a list of DOT titles and 9-digit codes which have been assigned to that group. Also included are selected occupational titles from the 1970 Census of Population, Classified Index of Industries and Occupations.[7] These were intended to provide additional insight into the content of the SOC, beyond that of the DOT titles.

The SOC Manual states, "In coding occupational data from surveys into the SOC, the 9-digit code of the *Dictionary of Occupational Titles*, Fourth Edition can be used as an alternative to direct coding."[8] This alternative is intended to provide additional flexibility in the system. The description of the SOC occupation (which is what one would use if directly coding), however, is not always synonymous with its DOT content. This is because while the SOC has listed corresponding components of the DOT within its structure, those components are not necessarily inclusive of every occupation under the SOC code. In other words, the aggregation of the content of the titles listed does not always capture every occupation in the SOC description. For example, SOC minor group clinical laboratory technologists and technicians (code 362), has a description which clearly would include the duties of a medical laboratory technician. This occupation, however, was not included in the DOT list accompanying the occupation (see table D for the *SOC Manual*, DOT content entries for this occupation). In fact, this occupation appears in another SOC occupation—health technologists and technicians (code 369)—in the *SOC Manual*. Agencies using the direct coding method would place these workers in with code 362 while those using the DOT content method would place them in code 369.

The DOT content alternative is attractive to users because it is more easily assimilated into computerized models than is the occupational description. This alternative formed the basis for the crosswalks that were developed to link various classification systems.

Updates to the SOC

The Bureau of Labor Statistics has prepared crosswalks showing how the OES codes relate to other codes including the SOC. The OES staff also worked with staff at the Employment and Training Administration to develop DOT/SOC matches. Similarly, the Bureau of the Census has independently revised its Classified Index of Occupations for use in the 1990 Census of Population and Housing that shows the detailed occupation title under each Census/SOC category.

These efforts were all undertaken to better serve the user community. These products, however, were prepared independently and thus inevitably result in inconsistencies across systems. This is particularly true when addressing cases where it is not clear-cut as to where to place a new occupation. Analysts sometimes are forced to find a 'best fit' for where they think a new occupation belongs. These 'best fit' decisions are by their nature subjective, and lead to inconsistencies across systems. An additional limitation of these products is that they can give the user a false sense that the data are more comparable than they actually are.

Uses of the SOC

Federal agencies are encouraged to use the SOC in their classification activities. Although no strict mandate is in force, the SOC has been followed in most cases by both the Census Bureau in the Census of Population and Current Population Survey and the Bureau of Labor Statistics in the Occupational Employment Statistics Survey. The Employment and Training Administration has dealt with the SOC by preparing a magnetic tape containing information about occupations in the *Dictionary of Occupational Titles*. Included is the SOC code associated with each specific DOT occupation. The utility of this information is limited, however, because there are usually numerous DOT codes under each SOC code and there is no way to properly aggregate the DOT information to the SOC level. One response to this problem is to provide that any future version of the DOT be assembled at the SOC level. In the interim, the OES system could be used to help classify occupations.

Conclusion

The 1980 SOC was a significant effort to assist users of occupational information by creating a common lan-

guage understood by all. Occupational information is certainly more comparable now than it was before the SOC was put in place. Nevertheless, as is the case with many first time efforts, there have been unforeseen problems in implementing the system. Architects of a new SOC would be wise to examine the implementation problems that occurred with the 1980 SOC to determine if there is a new approach needed. Additionally, consideration should be given to mandating the use of the SOC in all Federal occupational data collection efforts. Furthermore, the possibility of converting occupational information in administrative areas, such as the Office of Personnel Management's General Schedule system, might be examined. Finally, any new SOC should have a built-in mechanism to keep it up to date.

Table A. 1980 SOC pinciples of classification

1. Reflects the current occupational structure of the United States.
2. Classifies occupations on the basis of work performed.
3. Considers place of work (industry) only when warranted.
4. Classifies in homogeneous groups.
5. Classifies on the basis of the primary activity performed.
6. Assigns occupations at the lowest level of classification.
7. Large size should not by itself be considered sufficient reason for separate group identification.
8. Small size should not be considered sufficient reason for excluding a group from separate identification, although size must be considered.
9. Identifies supervisors separately from workers.
10. Classifies apprentices and trainees on the basis of their training.
11. Identifies helpers separately.
12. Gives secondary consideration to comparability to International Standard Classification of Occupations.

Table B. 1980 SOC occupational groups by selected categories

Occupational category	Divisions	Major	Minor	Unit
Total	20	58	214	538
Executive and administrative	1	2	19	18
Professional and technical	9	23	69	102
Sales	1	5	15	38
Clerical	1	2	13	[illegible]
Service	1	3	15	[illegible]
Agricultural and related	1	4	10	22
Production, construction, maintenance, transportation, etc	6	19	73	252

Table C. SOC finest level of occupational detail by selected major occupational categories

Occupational category	Number of detailed occupations
Total	664
Executive and administrative	33
Professional and technical	156
Sales	47
Clerical	66
Service	48
Agricultural and related	28
Production, construction, maintenance, transportation, etc	286

NOTE: Eight major groups (2-Digit) have no detail below them and 118 minor groups (3-Digit) have no detail below them.

Table D. Clinical laboratory technologists and technicians—minor group 382

This minor group includes occupations responsible for performing various chemical, microscopic, and/or bacteriologic laboratory tests to obtain data used in diagnosis and treatment of patients, or in determination of pathological condition of body. Dental laboratory technologists and technicians are classified in unit group 6865.

Medical technologist, teaching supervisor	573	078121010
Medical technologist, chief	573	078161010
Chemistry technologist	573	078261010
Microbiology technologist	323-573	078261014
Cytotechnologist	573	078281010
Medical technologist	573	078361014
Tissue technologist	573	078361030
Ultrasound technologist	573	078364010

NOTE: This example is taken from page 95 of the *Standard Occupational Classification Manual*, 1980.

Notes

[1] The original structure of the SOC was established by the Technical Committee on Occupational Classification. This committee never met again to oversee changes to the original structure.

[2] After the initial release of the two-volume SOC in 1977, the Office of Federal Statistical Policy and Standards realized that the *Manual* was not being used by major Federal agencies, and that its inclusion of the 1970 Census codes and in the *Dictionary of Occupational Titles* (third edition) codes rendered it obsolete almost immediately. Therefore, a decision was made to revise the SOC for use in the 1980 Census of Population and Housing.

[3] U.S. Department of Commerce, Bureau of the Census, 1990 Census of Population and Housing, Classified Index of Industries and Occupations. This index provides a definition and coverage of the current occupational classification system.

[4] The industry-occupation matrix uses the OES survey for staffing patterns data for all wage and salary workers. The matrix is a table which shows the distribution of occupational employment by industry. Data from the latest Decennial Census of Population are used for staffing patterns of wage and salary workers in agriculture; forestry; and fishing, hunting, and trapping. Staffing patterns for the private household industry and data on self-employed and unpaid family workers are derived from the Current Population Survey. Data on staffing patterns for the Federal Government are compiled by the Office of Personnel Management. The matrix includes detailed data for occupations, broken out by 3-digit Standard Industrial Classification (SIC) codes. It also includes detailed data for industries, broken out by 507 OES occupations.

[5] U.S. Department of Commerce, Office of Federal Statistical Policy and Standards; 1980 *Standard Occupational Classification Manual*, p. 8.

[6] International Labour Office, Geneva, 1990 International Standard Classification of Occupations: ISCO–88.

[7] U.S. Department of Commerce, Bureau of the Census, 1970 Census of Population and Housing: Classified Index of Industries and Occupations. This volume lists the individual job titles that constitute each 1970 census category. The appropriate 3-digit occupational code is listed with each title in the SOC. Only a small percentage of the 1970 census titles are indexed in the 1980 SOC.

[8] U.S. Department of Commerce, Office of Federal Statistical Policy and Standards; 1980 *Standard Occupational Classification Manual*, p. 10.

General Schedule Position Classification

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You will recall, when Commissioner Plewes was speaking earlier, he talked about various classification systems, the—pardon the acronyms—the SOC, the DOT, the OES, and there was another one down at the bottom, and it was called "the other." Well, I represent "the other" or one of the others.

Generally, what I've been asked to do is to tell you briefly about a classification system that's kind of—not kind of. It really is internal to the Federal Government, and while it has some uses for the government in the non-Federal sector, it's mainly used within the Federal Government. That is, the General Schedule system of occupational classification.

It differs somewhat from the Standard Occupational Classification system and the *Dictionary of Occupational Titles*, in one way in terms of the number of occupations and how these occupations are put together and described.

The DOT has approximately 13,000 different occupational definitions, and SOC has about 660. By way of contrast, the General Schedule has approximately 450 different occupational groupings. Now that's kind of cheating a little bit, because there is a second system we use within the Federal Government for blue-collar work called the Federal Wage System, and that in itself has about 285 different occupations; but my main concern here in talking to you is to talk about the white-collar or the General Schedule occupational system.

The system is really not structured or set up to collect or to assist in the collection of information about data, people, and things. It is not set up for purposes of being used for counseling, training or other similar purposes.

The occupational structure under the General Schedule in the Federal Government, however, can be used and is used, in fact, for informational gathering purposes. That is, for a broad grouping of jobs within this General Schedule that's called—acronym—PATCO. PATCO stands for Professional, Administrative, Technical, Clerical and one of those "Others." That's the "O" on the end.

The PATCO categories are used by the Department of Labor in some of their salary survey efforts to collect information from the private sector on the amount of people in a particular occupational grouping such as engineer and level of engineer, and the weighted average salaries and things of this nature; and it's published periodically.

It's used both, I know, by people in the private and non-Federal sector, and the data is also used, to a greater or lesser extent, in the pay setting processes within the Federal Government; but that is not the specific purpose for our design of the occupational structure within the General Schedule.

The system itself was born way back in the early 1920's. It was set up by Congress into statutorily defined pay grades and occupational groups in 1923. At that time they set up four occupational groups: Professional; subprofessional (the subprofessional was the technicians and technologists that supported professional groups); clerical, administrative and fiscal; and what was then called the custodial service.

These four groups were then subdivided statutorily into pay grades based on the nature of the work, the level of the difficulty, and the degree of responsibility.

The purpose at the time was to bring a semblance of rationality to the grouping of work in the Federal Government, and the method for assigning pay and pay grades, which in turn established pay relationships among the various occupations based on things other than whimsy, or where you worked, or who you knew, or things of that nature.

Later on, back in 1949, another act was passed by Congress that is now referred to as the Classification Act of 1949. It basically carried on the work from 1923, but it collapsed those four separate groups, or five separate groups which later evolved, into one. That's the one I'm referring to today as the General Schedule.

The General Schedule, to a certain extent, though it's a unitary system, has two groups, two main groups within it, professional/administrative and technical/clerical. It kind of links up with what I referred to earlier as the PATCO categorizations for data collection purposes, but they really at this time, and for historical purposes, really have no other meaning in fact in terms of how the occupations are described, if you will.

This system, the one instituted in 1949, is also statutorily based. That is, it's based on a set of requirements spelled out very specifically in law that determines the various break points in the occupations, and the break points essentially are the grades.

It is a system that's based on operational needs, the operational needs of the Federal Government.

It's found in title 5, United States Code, and states that positions will, in accordance with their duties, re-

sponsibilities, and qualification requirements, be grouped and identified by classes and grades so that the resulting position classification system can be used in all phases of personnel administration, not just occupational structuring, not just pay setting or grade setting, but for various other staffing and reduction in force and things of this nature.

This leads us to the question of how do we set up— How do we decide to set up new occupations in the Federal Government? What kind of scientific crystal ball do we use in doing it?

Basically, the 450 occupations I referred to reflect how the work is structured in the Federal Government. It's kind of looking at what was referred to earlier as the use of skills. It's not looking at where the skills came from. It's looking at how are they used in the various agencies within the Federal Government.

To a great extent, it mirrors work found in the private sector, public sector, as well as academia, but the occupations, when they are indeed set up, reflect the needs of the employers, the various Federal agencies.

The 450 occupations within the Federal Government in the General Schedule system are broken down into 21 groups. The groups are, to a certain extent, not unlike some of the groupings in the Standard Occupational Classification system.

They include the biological sciences, medical/hospital/dental, public health, engineering, and architecture. We set up these new occupations and delete occupational categories again based on agency needs.

New occupations are set up when something emerges that has not, or cannot, fit into existing occupational categories where the Federal population in this new emerging category becomes large enough to justify separate status, and when such status—that is, a separate occupation—is needed in order to lessen or alleviate problems in finding, recruiting, and retaining personnel needed to keep the Federal Government system operating.

I will stop at this point. When we do have a chance, if you have any questions, I'll be glad to answer them for you. Thank you very much.

Summary of Occupational Classification Requirements

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The Office of Compensation and Working Conditions has a diverse set of programs which have differing needs for occupational classification. This paper describes three of the programs, their needs, and the ways in which occupational classifications are used.

The Occupational Compensation Survey program

The program. The Occupational Compensation Survey program (OCSP) of the Bureau of Labor Statistics (BLS) provides data on occupational pay and benefits for selected work levels of white-collar and blue-collar occupations.

The principal Federal Government clients of the OCSP are the President's Pay Agent and the Employment Standards Administration (ESA). (The Pay Agent comprises the Secretary of Labor and the Directors of the Office of Personnel Management and the Office of Management and Budget.) The Pay Agent uses OCS results in determining the adjustments to Federal pay which are necessary to achieve comparability with pay in the nonfederal sector. ESA uses OCS data to administer the Service Contract Act, which requires Federal service contractors to pay their employees locally prevailing wages and benefits. These requirements determine the way in which jobs are described and the way in which they are chosen. The Pay Agent's role in compensation administration is basic. OCS data are also widely used by compensation administrators in private industry and State and local governments.

Compensation administration. Typically, a system of compensation administration in an organization consists of two processes: (1) develop an internal pay structure for the organization; and (2) compare it to the pay structure of the external labor market.

An internal pay structure is an array of occupational pay rates in which a set of jobs are related systematically to one another according to the relative worth of each. Most methods rely on careful job evaluations to assess the value of each job in the pay structure.

The Office of Personnel Management, for example, has developed job standards which define occupations and job levels within them. This is usually done through a Factor Evaluation System which analyzes nine factors such as knowledge, supervisory controls, and job complexity, and assigns a point value to each. The sum of the points for all nine factors determines the General Schedule grade for the job. Atypical jobs are evaluated on a more general, less detailed basis by which they are slotted into the classification structure.

Having developed the internal pay structure the organization compares it to the external labor market—usually, by means of a survey. This provides a basis for assuring that the pay structure is competitive in the relevant labor market, but not unnecessarily high.

The processes of job evaluation described above are greatly facilitated by the use of a set of "benchmark" jobs as points of reference. Benchmark jobs are key jobs in the organization which help to anchor the internal structure in terms of widely known and accepted characteristics which are clearly relevant to work in the organization. Benchmark jobs can also serve as the linkage between the internal pay structure and the external.

Data. In the Federal Government system, the Pay Agent has selected 26 occupations which provide benchmark representation of the Federal sector and are relatively common in the nonfederal sector. The Bureau of Labor Statistics and the Office of Personnel Management have developed survey descriptions for these 26 occupations, including multiple job levels within each. Survey data based on these descriptions are the basis for comparing salaries of Federal and nonfederal workers.

The purpose of ESA is different, but the nature of the data requirement is quite similar. To administer the Service Contract Act, the ESA has selected a variety of white- and blue-collar occupations most commonly employed in the carrying out of service contracts for the Federal Government. Then, the OCS data are used to set minimum wages for employees of contractors who are subject to the Act. This requires narrow and accurate job descriptions to provide for effective job matching.

These needs guide the OCS choices of jobs and methods of job description. The occupational descriptions used in the OCS differ considerably from the Standard Occupational Classification (SOC) designations in that they are keyed to a relatively small number of very specifically defined occupations and job levels, and have highly technical exclusions and inclusions. The SOC in contrast is designed to be broadly based and to include most if not all the workforce.

The Employment Cost Index program

The program. The Employment Cost Index (ECI) is designed to produce a comprehensive and timely measure of changes in employee compensation in the U.S economy. Employee compensation is defined as wages and salaries and employer costs for employee benefits. The ECI is fixed-weighted so that it is not affected by employment shifts among occupations and industries with different wage and compensation levels.

Examples of ECI uses. The ECI, a principal Federal economic indicator, is an appropriate measure to use in analyzing the relationships between changing output, prices, productivity, employment, and labor costs. It is used extensively for such analyses by federal agencies and by private analysts and forecasters.

The Ethics Reform Act of 1989 specifies that the ECI will be used to adjust the pay of members of Congress, Federal judges, and senior government officials. The Federal Pay Comparability Act of 1990 provides that the ECI will also be used to adjust the pay of white-collar federal employees.

The Department of Defense uses the ECI in monitoring the change in labor costs in purchase contracts, and the Health Care Financing Administration uses the ECI as part of a hospital input price index under Medicare. State and local governments use the ECI for similar purposes. The private sector uses the ECI as a labor cost escalator in long term contracts and as a wage escalator in collective bargaining agreements.

Although the primary output from the ECI is data on rates of change in compensation costs, levels of pay are also provided. The cost levels are based on the data collected to produce the index numbers for the ECI. While the ECI program uses fixed employment weights from the Census of Population for the index, it uses current employment weights for the cost levels. The BLS Current Employment Statistics are combined with ECI sample weights to yield those current weights.

Data. The ECI is designed to show trends in compensation costs in the aggregate and by major industry and occupational categories. The relatively small size of the ECI sample precludes publication by detailed occupation. However, the ECI needs data from an internally consistent, detailed classification system to weight its survey data and compute its outputs.

The ECI uses the occupational classification system of the Census of Population. The ECI is designed as a fixed-weight index at the occupational level, thus eliminating the effects of employment shifts among occupations. The index weights are derived from occupational employment for ECI industries reported in the Census. The weights remain fixed from period to period pending a reweighting, which occurs once every 10 years.

The survey method starts with a sample of jobs in an establishment and then aggregates to the desired level. Currently, the method used in the ECI is to first obtain any company document which includes all employees of the establishment, either by their name or by their employment in specific job titles. From that list, four to eight individuals, the number depending on the size of the establishment, are selected randomly. For each of those individuals, their specific job is identified, and a list compiled of all workers in that job. Each job selected must be defined narrowly enough that all workers in it have about the same duties performed at about the same level of skill, but broadly enough that it is maintainable (that is, that it will be possible to continue to collect updates to the data in the future). The wage and benefit data for each job are averages for all workers in the job. The jobs are classified in the appropriate Census occupational category and weighted up to a more aggregative level. For index estimation, the fixed employment weights are applied at the level of the major occupational group within the industry division.

The published occupational groups are:

1. Professional, specialty, and technical.
2. Executive, administrative, and managerial.
3. Sales.
4. Administrative support, including clerical.
5. Precision production, craft, and repair.
6. Machine operator, assembler, and inspector.
7. Transportation and material handling.
8. Handler, equipment cleaner, helper, and laborer.
9. Service.

Occupational Safety and Health Survey

The program. The Occupational Safety and Health (OSH) Survey is a nationwide annual survey covering occupational injury and illness cases and their characteristics. The survey data describe the worker and the facts associated with all disabling cases, defined as those injuries and illnesses serious enough to require workers to miss at least 1 workday above and beyond the day of injury or onset of illness.

The data are useful in developing standards and programs for a safer working environment. Employers and employees are alerted to hazards and aided in removing them. The data can help identify those safety standards that require stricter enforcement or revision and highlight areas where new standards are needed. Inspectors can work more effectively having extensive knowledge of the incidence of injuries and illnesses.

Requirements. The OSH Survey requires an occupational coding structure that includes a numerical classification system of occupational groups and a comprehensive alphabetical index of job titles. The structure should be

designed primarily for use in assigning numerical codes to a job title. Job titles are frequently identical among industries; therefore, the alphabetical list should display appropriate Standard Industrial Classification (SIC) codes to differentiate between identical titles.

The features specified above for an occupational coding structure are dictated by the design of the OSH survey. Employers participating in the survey are required to provide selected information about a worker who was injured or made ill on the job and lost work time as a result. This information includes occupation, sex, age, race, and length of service. In addition, the employer is asked to describe the incident that resulted in the injury or illness.

After collection, the jobs that have been reported by employers are assigned occupational codes. Then, cross-tabulations based on occupation and other demographic variables and other collected data, such as industry and the nature or source of the accident, can be developed to correlate types of jobs, industries, and incidents that occur in the workplace.

Data. The BLS Office of Safety, Health, and Working Conditions (OSHWC) has selected for the *OSH Occupational Coding Manual* the structure developed by the Bureau of the Census. The "Alphabetical Index of Industries and Occupations" was developed by the Census primarily for use in classifying a respondent's industry and occupation as reported in the 1990 Census of Population and the Current Population Survey.

The *Census 1990 Index of Occupations* lists approximately 30,000 occupation titles, a majority of which have been assigned one or more of the Census' industry codes, thus meeting OSH needs for a comprehensive list of titles with industrial designations. The numerical list of job codes has approximately 500 3-digit codes associated with separate categories of occupations. These categories of jobs can be grouped together during tabulation, depending on publication and other criteria for aggregation.

OSHWC made one modification to the Census structure. The industrial designations in the Census alphabetical list are based on industry codes developed by the Census, whereas employers participating in the OSH survey are assigned SIC codes. Therefore, the OSHWC replaced all Census industry codes with the equivalent SIC's.

Census Occupational Classification System and the Standard Occupational Classification

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Background

The decennial censuses of population have asked questions on occupation since 1850. An occupation classification system similar to the current classification has been used since 1940. This 1940 occupational classification was also the first to have most of the industry concept removed from the occupational classification. For example, in 1930, there was a category under trade titled "laborers, porters, and helpers in stores." Public service had the category "laborers (public service)" which included garbage collectors. In 1940, both kinds of laborers were put into one "laborer" major group. Porters, however, became service workers along with railroad porters. The census of 1940 was also the first census to distinguish between those employed and those unemployed.

The 1940 classification had 11 major groups. These were:

- Professional and semiprofessional workers;
- Farmers and farm managers;
- Proprietors, managers, and officials, except farm;
- Clerical, sales, and kindred workers;
- Craftsmen, foremen, and kindred workers;
- Operatives and kindred workers;
- Domestic service workers;
- Protective service workers;
- Service workers, except domestic and protective;
- Farm laborers and foremen; and
- Laborers, except farm.

These major groups have been fairly stable since then. In 1950, "sales workers" became a major group, and "protective service" was merged with the "service, except domestic," to become "service workers, except private household" ("domestic workers" were changed to "private household workers.") Also in 1950, the professional group was retitled "professional, technical, and kindred workers." There were no major group changes in 1960. In 1970, the transportation-related occupations in the operatives major group were put into a new major group called "transport operatives." The occupational classification then had 12 major groups. When the 1980 classification was developed, using the Standard Occupational Classification (SOC), developed in the 1970's, technicians became a new major group, the two farm major groups were merged, and the protective service occupations again became a major group, as in 1940. Thus, 1980 had 13 major groups. In 1990, a 14th major group, "military occupations," was defined. Because most of our data are shown for a civilian universe, this group is not included in most tables. The current (1990) major groups are presented in appendix 1.

The number of detailed categories in the census occupational classification has increased over time. The number by census year is shown in table 1.

Table 1. Number of detailed census occupational titles, 1940–90

Census year	Number of categories	Census year	Number of categories
1940	226	1970	[1] 440
1950	269	1980	503
1960	297	1990	501

[1] The occupation coders had 424 categories. The 440 includes an "allocation category" for each major group, and a division of the "salesmen and sales clerks, n.e.c." category into five groups. These were all developed in the computer edits.

The number of categories increased modestly until 1970. After the 1960 census there was criticism of the classification because about 30 percent of the employed were in six large "not elsewhere classified" categories. The increase in categories from 297 to 440 was in response to that criticism. Two additional occupation questions were added to the 1970 census questionnaire to obtain the detail to enable the Census Bureau to identify more occupations. (See more on this in the section on data collection.)

The conversion of the census classification to make it comparable to the SOC caused another large increase for 1980. This also caused the largest revision in the content of detailed categories since the major 1930 to 1940 classification conceptional change. The 1990 classification, also based on the SOC, has four new categories, but six pairs of occupations were combined for a net loss of two. (A list of changes between 1980 and 1990 is shown in appendix 2.) One of the occupations dropped, telegraphers, no longer exists in the traditional sense. Two of the other combinations were implemented because the categories were not being measured well. These were "short-order cooks," and "truck drivers, light." Respondents to the census and surveys did not give the

information needed to separate short-order cooks from other cooks. The same applies to truck drivers as respondents did not report on the weight of the truck. The other three combinations involved small occupations, all less than 5,000, that we felt were not being well measured.

The changes from 1980 to 1990 illustrate the tension in developing census classifications. We try to present to users as much occupational detail as possible, but must have reasonably useful and valid categories.

Data collection

Census or survey questionnaires collect the job information we use to classify occupations. Thus, question wording is critically important for obtaining the detail needed to properly classify the job to an occupation. The 1950 and 1960 censuses asked but one question: "What kind of work was he doing?" In 1970, along with the expansion of the occupational classification, two additional questions were asked: "What were his most important activities or duties?" and "What was his job title?" Job title was not asked again, but the other two questions were asked in 1980 and 1990. The job title question was left off in part because of the limited space on the questionnaire and the kind of work and activity questions gave a more precise description of the job. The coders would often use the job title to assign what was not really the best code.

We also obtain a description of the respondent's industry in our censuses and surveys. Our demographic census industry classifications are developed in a manner similar to occupation. It is based on the Standard Industrial Classification, but shows only the detail our responses allow. Industry is important in classification of occupational titles that have different meanings in different industries. Our occupational classification system often uses the industry code to differentiate between two or more occupational titles.

Standard occupational classification

A letter was sent from the Bureau of the Budget to 28 agencies in August 1965. It asked about the desirability of establishing a standard occupational classification. Based on the responses to this letter, work on the *Standard Occupational Classification Manual* began in December 1966 to develop a classification system similar to the Standard Industrial Classification. It was determined that this new standard could not be completed in time for it to be used in the 1970 census, and work was suspended to allow for the completion of the 1970 census classification.

Some early work on the SOC is reflected in the 1970 classification, primarily the professional major group. Rather than arrange the occupations in alphabetical order as in earlier censuses, we put most of the occupations into minor groups. For example, the 1970 "life and physical scientists" is similar to the SOC minor group "natural scientists." The 1970 "writers, artists, and entertainers" minor group was made up from an early draft of the SOC's division "writers, artists, entertainers, and athletes."

Work on the SOC classification was resumed in 1974. The first edition of the SOC was published in 1977. There was enough public comment to cause the SOC "Occupational Classification Committee" to decide to do a revision almost immediately. Thus, the 1977 edition was never used, and a revised version was issued in 1980. Because the 1980 version was the only one ever used, for all practical purposes it is the first edition.

The 1980 SOC is a hierarchical classification system. It has four levels—divisions, major groups, minor groups, and unit groups. The 22 divisions were not numbered. The 60 major groups have two numeric digits, the 214 minor groups have three digits, and the 538 unit groups have four digits. Some minor groups do not have unit groups, so the total number of unique categories (663) is greater than the count of unit groups. The SOC Manual provides for six summary groupings of occupations. These are:

Administrative, engineering, scientific, teaching, and related occupations, including creative artists (major groups 10–34);

Technical, clerical, sales, and related occupations (major groups 36–48);

Service occupations, including military occupations (major groups 50–53 and 91);

Farming, forestry, fishing, and hunting occupations (major groups 55–58);

Precision production, craft and repair (major groups 60–69);

Operators, fabricators and laborers (major groups 71–87).

The Census also uses these summary categories. Our wording is:

- Managerial and professional specialty occupations;
- Technical, sales, and administrative support occupations;
- Service occupations;
- Farming, forestry, and fishing occupations;
- Precision production, craft, and repair occupations; and
- Operators, fabricators, and laborers.

These summary categories are used in two ways at the Bureau. First, they are shown as subtotal lines in our tables showing detailed occupations; second, they are used to approximate social status in tables featuring other

subjects, such as marital status. This is especially true for cross-tabulations of other data from current surveys.

The census occupational classifications have tried to be as true to the SOC as possible. The classification committee knew that Census could not measure all the occupations in the system. Our 1980 classification had 503 detailed categories versus the SOC's 663 unique categories. The area that accounts for most of the census shortfall is in SOC major groups 73–74, "machine setup operators" and 75–76, "machine operators and tenders." The decennial census does not get the detail from household respondents to determine if a machine operator sets up his machine or not. So we place both kinds of jobs in our minor group "machine operators, and tenders except precision." Another major difference between Census and SOC is that the SOC had 22 divisions, which were too many to be used for census summary tabulations. We merged seven of these divisions to create a professional major group. Most of the other SOC divisions became major groups in the Census classification.

At the unit group level, Census has a few categories classified differently from the SOC. One is "Airplane pilots and navigators." The 1970 census and early drafts of the SOC had pilots with technicians. The 1977 and 1980 SOC's moved them to "transportation occupations." We kept them with technicians because the education and earnings of pilots were so much higher than others in the transportation group that the pilots would distort the characteristics of that group. Technical writers are classified in the same minor group as "authors," and "editors and reporters" rather than with technicians. This was done because it is not always clear to which category a writer properly belongs, and we wanted to limit the confusion to one minor group. A similar change was made in the "administrative support occupations, including clerical" major group. The SOC has "general office occupations" as a minor group following the unit group "typists," which is near the beginning of the division. Census has "general office occupations" as a detailed category within the last minor group of the division, "miscellaneous administrative support occupations," because it collects data about many clerical people who do not report any specific duty. In this regard it is similar to the "not elsewhere classified" category in that minor group. The last example where different major groups are involved in classification differences is "parking lot attendants." Census put them with "motor vehicle operators;" the SOC has them with the "handlers, equipment cleaners, and laborers" division. We felt these workers needed to drive to park cars, and that was the most significant skill for the job.

The lack of detailed responses on census questionnaires prevents us from showing a number of SOC unit group occupations. The census "executive" major group has a large residual category, because our language does not do a good job of distinguishing levels of management. Included in this residual is the SOC "general managers and other top executives." This is one occupation our data users would like to have, but we unfortunately cannot identify them. Two of the new occupations for 1990 came from this large residual category.

Two more examples of census questionnaire responses preventing us from precisely following the SOC are "tile setters" and "printing" occupations. The SOC has "hard tile setters" and "soft tile setters" in two separate minor groups. We put them together because the type of tile is often not reported. Census also merged the precision printing occupations with the printing machine operators, again because we cannot tell the difference between the two in household surveys.

There is one part of the classification where we do show detailed occupations even though they are under reported. The census classification has 28 specific occupations under the minor group "teachers, postsecondary," and one additional "subject not specified" category. The 1990 census data had 78 percent of the postsecondary teachers in this not specified category, with the remaining 22 percent distributed among the 28 specific groups. We keep these groups because the National Science Foundation and others want to look at the characteristics of these specific occupations, even if they are under reported. (The 1990 occupation classification system sorted by SOC code is presented as appendix 3.)

Dictionary of Occupational Titles

The *Dictionary of Occupational Titles* (DOT) has been a tool we have used since it was first published in 1939. It has served as our eyes and ears on defining new titles. We find new titles in our current survey work and test censuses, but do not have any direct way to determine the work functions of these new jobs, necessary for classification. The DOT has done that for us. It has also been a tool to help train new second level coders, those who solve problems found by our first level coders. The DOT can meet our most important need if we will be able to obtain new titles found by the DOT field staff when we are developing the occupational classification for an upcoming census.

The current DOT has some titles that are broader in scope than the SOC. This presented a problem when the 1980 SOC was developed. These DOT titles were assigned to one SOC unit group, but the DOT definition encompassed several SOC unit groups. In the case of SOC 22, "Teachers; college, university, and other postsecondary institutions," the DOT title "faculty member, college or university" was assigned to major group 22, and most of the unit groups do not have any DOT titles assigned to them. The DOT titles should not be broader in scope than the SOC unit group it is assigned to. If special broader titles are needed in the DOT, that title should show the range of SOC titles it covers. It would also be useful if the DOT's 3-digit occupational

groups had a closer relationship to the SOC unit groups. Users could then sort DOT data into the SOC. Conversely, other users would be able to impute DOT worker functions and other occupational analysis characteristics to survey data sets.

If the DOT titles and 3-digit occupational groups had a closer, cleaner relationship to one another, the DOT does not necessarily need to use the SOC as its main classification system. This divergence may actually be desirable because the DOT serves a different group of users than do the data from the Census and the Occupational Employment Survey.

Recommendations

The 1980 SOC needs and should be updated before the 2000 census. However, we strongly believe it should not have a major change in classification. The change to the 1980 SOC made comparability with earlier censuses difficult. The public deserves a few more censuses before another major change in classification is introduced.

A DOT, or some other method, should be in place to find and analyze new occupations as they are developed in the economy. This information could be used to classify the new occupations and add them to the SOC.

Let's consider making the SOC dynamic rather than static—changing as the economy changes, rather than reflecting only the past.

Appendix A.

1980 and 1990 Bureau of the Census major occupation groups compared to 1980 standard occupation classification divisions

1980 Standard Occupational Classification divisions[1]	1980 and 1990 Bureau of Census occupational major groups
Executive, administrative, and managerial occupations	Executive, administrative, and managerial occupations
Engineers, surveyors, and architects Natural scientists and mathematicians Social scientists, social workers, religious workers, and lawyers Teachers, librarians, and counselors Health diagnosing and treating practitioners Registered nurses, pharmacists, dietitians, therapists, and physician's assistants Writers, artists, entertainers, and athletes	Professional specialty occupations
Health technologists and technicians Technologists and technicians, except health	Technicians and related support occupations
Marketing and sales occupations	Sales occupations
Administrative support occupations, including clerical	Administrative support occupations, including clerical
Service occupations Private household occupations	Private household occupations
Service occupations Protective service occupations	Protective service occupations
Service occupations Service occupations, except private household and protective	Service occupations, except protective and household
Agricultural, forestry and fishing occupations	Farming, forestry, and fishing occupations
Mechanics and repairers Construction and extractive occupations Precision production occupations	Precision production, craft, and repair occupations
Production working occupations	Machine operators, assemblers, and inspectors
Transportation and material moving occupations	Transportation and material moving occupations
Handlers, equipment cleaners, helpers, and laborers	Handlers, equipment cleaners, helpers, and laborers
Military occupations	Military occupations[2]
Miscellaneous occupations	Not used

[1] Major groups for the "service" division.
[2] Used in 1990 only.

Appendix B. 1980 Occupation Categories That Had Title or Code Changes for the 1990 Census of Population

1980 code and category	*1990 code and category*
Occupation split categories	
019 Managers and administrators n.e.c.	017 Managers, food serving and lodging establishments 021 Managers, service organizations, n.e.c. 022 Managers and administrators, n.e.c.
468 Child-care workers, except private household	466 Family child-care providers 467 Early childhood teacher's assistants 468 Child-care workers, n.e.c.
Occupation merged categories	
1980 code and category	*1990 code and category*
349 Telegraphers 353 Communications equipment operators, n.e.c.	353 Communications equipment operators, n.e.c.
368 Weighers, measurers, and checkers 369 Samplers	368 Weighers, measurers, checkers and samplers
436 Cooks, except short order 437 Short-order cooks	436 Cooks
673 Apparel and fabric patternmakers 674 Miscellaneous precision apparel fabric workers	674 Miscellaneous precision apparel and fabric workers
794 Hand grinding and polishing operations 795 Miscellaneous hand working occupations	795 Miscellaneous hand working occupations
804 Truck drivers, heavy 805 Truck drivers, light	804 Truck drivers
Occupation—title changed, same code	
1980 code and category	*1990 code and category*
098 Inhalation therapists 558 Supervisors, n.e.c. 734 Printing machine operators	098 Respiratory therapists 558 Supervisors, constructing, n.e.c. 734 Printing press operators
Occupation—codes changed, same title	
1980 code and category	*1990 code and category*
017 Postmasters and mail superintendents	016 Postmasters and mail superintendents
016 Managers, properties and real estate	018 Managers, properties and real estate
018 Funeral directors	019 Funeral directors
463 Guides	461 Guides
464 Ushers	462 Ushers
465 Public transportation attendants	463 Public transportation attendants
466 Baggage porters and bellhops	464 Baggage porters and bellhops
467 Welfare service aides	465 Welfare service aides
633 Supervisors, production occupations	628 Supervisors, production occupations
863 Supervisors, handlers, equipment cleaners, and laborers, n.e.c.	864 Supervisors, handlers, equipment cleaners, and laborers, n.e.c.
864 Helpers, mechanics and repairers	865 Helpers, mechanics and repairers
865 Helpers, construction trade	866 Helpers, construction trade
866 Helpers, surveyor	867 Helpers, surveyor
867 Helpers, extractive occupations	868 Helpers, extractive occupation
873 Production helpers	874 Production helpers

Appendix C.

1990 Census of Population occupational classification system

1990 census code	Title
	Managerial and Professional Specialty
	Executive, Administrative, and Managerial Occupations
003	Legislators (111)
004	Chief executives and general administrators, public administration (112)
005	Administrators and officials, public administration (1132–1139)
006	Administrators, protective services (1131)
007	Financial managers (122)
008	Personnel and labor relations managers (123)
009	Purchasing managers (124)
013	Managers, marketing, advertising, and public relations (125)
014	Administrators, education and related fields (128)
015	Managers, medicine and health (131)
016	Postmasters and mail superintendents (1344)
017	Managers, food serving and lodging establishments (1351)
018	Managers, properties and real estate (1353)
019	Funeral directors (pt 1359)
021	Managers, service organizations, n.e.c. (127, 1352, 1354, pt 1359)
022	Managers and administrators, n.e.c. (121, 126, 132-1343, 136–139)
	Management related occupations
023	Accountants and auditors (1412)
024	Underwriters (1414)
025	Other financial officers (1415, 1419)
026	Management analysts (142)
027	Personnel, training, and labor relations specialists (143)
028	Purchasing agents and buyers, farm products (1443)
029	Buyers, wholesale and retail trade, except farm products (1442)
033	Purchasing agents and buyers, n.e.c. (1449)
034	Business and promotion agents (145)
035	Construction inspectors (1472)
036	Inspectors and compliance officers, except construction (1473)
037	Management related occupations, n.e.c. (149)
	Professional Specialty Occupations
	Engineers, architects, and surveyors
043	Architects (161)
	Engineers
044	Aerospace (1622)
048	Chemical (1626)
049	Nuclear (1627)
053	Civil (1628)
054	Agricultural (1632)
055	Electrical and electronic (1633, 1636)
056	Industrial (1634)
057	Mechanical (1635)
058	Marine and naval architects (1637)
059	Engineers, n.e.c. (1639)
063	Surveyors and mapping scientists (164)
	Mathematical and computer scientists
064	Computer systems analysts and scientists (171)
065	Operations and systems researchers and analysts (172)
066	Actuaries (1732)
067	Statisticians (1733)
068	Mathematical scientists, n.e.c. (1739)
	Natural Scientists
069	Physicists and astronomers (1842, 1843)
073	Chemists, except biochemists (1845)
074	Atmospheric and space scientists (1846)
075	Geologists and geodesists (1847)
076	Physical scientists, n.e.c. (1849)
077	Agricultural and food scientists (1853)
078	Biological and life scientists (1854)
079	Forestry and conservation scientists (1852)
083	Medical scientists (1855)
	Health Diagnosing Occupations
084	Physicians (261)
085	Dentists (262)
086	Veterinarians (27)
087	Optometrists (281)
088	Podiatrists (283)
089	Health diagnosing practitioners, n.e.c. (289)
	Health assessment and treating occupations
095	Registered nurses (29)
096	Pharmacists (301)
097	Dietitians (302)
	Therapists
098	Respiratory therapists (3031)
099	Occupational therapists (3032)
103	Physical therapists (3033)
104	Speech therapists (3034)
105	Therapists, n.e.c. (3039)
106	Physicians' assistants (304)
	Teachers, Postsecondary
113	Earth, environmental, and marine science teachers (2212)
114	Biological science teachers (2213)
115	Chemistry teachers (2214)
116	Physics teachers (2215)
117	Natural science teachers, n.e.c. (2216)
118	Psychology teachers (2217)
119	Economics teachers (2218)
123	History teachers (2222)
124	Political science teachers (2223)
125	Sociology teachers (2224)
126	Social science teachers, n.e.c. (2225)
127	Engineering teachers (2226)
128	Mathematical science teachers (2227)
129	Computer science teachers (2228)
133	Medical science teachers (2231)
134	Health specialties teachers (2232)
135	Business, commerce, and marketing teachers (2233)
136	Agriculture and forestry teachers (2234)
137	Art, drama, and music teachers (2235)
138	Physical education teachers (2236)
139	Education teachers (2237)
143	English teachers (2238)
144	Foreign language teachers (2242)
145	Law teachers (2243)
146	Social work teachers (2244)
147	Theology teachers (2245)
148	Trade and industrial teachers (2246)
149	Home economics teachers (2247)
153	Teachers, postsecondary, n.e.c. (2249)
154	Postsecondary teachers, subject not specified

1990 census code	Title	1990 census code	Title
	Teachers, Except Postsecondary	229	Computer programmers (3971, 3972)
155	Teachers, prekindergarten and kindergarten (231)	233	Tool programmers, numerical control (3974)
156	Teachers, elementary school (232)	234	Legal assistants (396)
157	Teachers, secondary school (233)	235	Technicians, n.e.c. (399)
158	Teachers, special education (235)		*Sales Occupations*
159	Teachers, n.e.c. (236, 239)	243	Supervisors and proprietors, sales occupations (40)
163	Counselors, educational and vocational (24)		*Sales Representatives, Finance, and Business Services*
	Librarians, Archivists, and Curators	253	Insurance sales occupations (4122)
164	Librarians (251)	254	Real estate sales occupations (4123)
165	Archivists and curators (252)	255	Securities and financial services sales occupations (4124)
	Social Scientists and Urban Planners	256	Advertising and related sales occupations (4153)
166	Economists (1912)	257	Sales occupations, other business services (4152)
167	Psychologists (1915)		*Sales Representatives, Commodities Except Retail*
168	Sociologists (1916)	258	Sales engineers (421)
169	Social scientists, n.e.c. (1913, 1914, 1919)	259	Sales representatives, mining, manufacturing, and wholesale (423, 424)
173	Urban planners (192)		*Sales Workers, Retail, and Personal Services*
	Social, Recreation, and Religious Workers	263	Sales workers, motor vehicles and boats (4342, 4344)
174	Social workers (2032)	264	Sales workers, apparel (4346)
175	Recreation workers (2033)	265	Sales workers, shoes (4351)
176	Clergy (2042)	266	Sales workers, furniture and home furnishings (4348)
177	Religious workers, n.e.c. (2049)	267	Sales workers; radio, TV, hi-fi, and appliances (4343, 4352)
	Lawyers and Judges	268	Sales workers, hardware and building supplies (4353)
178	Lawyers (211)	269	Sales workers, parts (4367)
179	Judges (212)	274	Sales workers, other commodities (4345, 4347, 4354, 4356, 4359, 4362, 4369)
	Writers, Artists, Entertainers, and Athletes	275	Sales counter clerks (4363)
183	Authors (321)	276	Cashiers (4364)
184	Technical writers (398)	277	Street and door-to-door sales workers (4366)
185	Designers (322)	278	News vendors (4365)
186	Musicians and composers (323)		*Sales related occupations*
187	Actors and directors (324)	283	Demonstrators, promoters and models, sales (445)
188	Painters, sculptors, craft-artists, and artist printmakers (325)	284	Auctioneers (447)
189	Photographers (326)	285	Sales support occupations, n.e.c. (444, 446, 449)
193	Dancers (327)		*Administrative Support Occupations, Including Clerical Supervisors, administrative support occupations*
194	Artists, performers, and related workers, n.e.c. (328, 329)	303	Supervisors, general office (4511, 4513, 4514, 4516, 4519, 4529)
195	Editors and reporters (331)	304	Supervisors, computer equipment operators (4512)
197	Public relations specialists (332)	305	Supervisors, financial records processing (4521)
198	Announcers (333)	306	Chief communications operators (4523)
199	Athletes (34)	307	Supervisors; distribution, scheduling, and adjusting clerks (4522, 4524–4528)
	Technical, Sales, and Administrative Support Occupations		*Computer equipment operators*
	Technicians and Related Support Occupations	308	Computer operators (4612)
	Health technologists and technicians	309	Peripheral equipment operators (4613)
203	Clinical laboratory technologists and technicians (362)		*Secretaries, stenographers, and typists*
204	Dental hygienists (363)	313	Secretaries (4622)
205	Health record technologists and technicians (364)	314	Stenographers (4623)
206	Radiologic technicians (365)	315	Typists (4624)
207	Licensed practical nurses (366)		*Information clerks*
208	Health technologists and technicians, n.e.c. (369)	316	Interviewers (4642)
	Technologists and technicians, except health	317	Hotel clerks (4643)
	Engineering and Related Technologists and Technicians	318	Transportation ticket and reservation agents (4644)
213	Electrical and electronic technicians (3711)	319	Receptionists (4645)
214	Industrial engineering technicians (3712)	323	Information clerks, n.e.c. (4649)
215	Mechanical engineering technicians (3713)		*Records processing occupations, except financial*
216	Engineering technicians, n.e.c. (3719)	325	Classified-ad clerks (4662)
217	Drafting occupations (372)	326	Correspondence clerks (4663)
218	Surveying and mapping technicians (373)	327	Order clerks (4664)
	Science technicians	328	Personnel clerks, except payroll and timekeeping (4692)
223	Biological technicians (382)	329	Library clerks (4694)
224	Chemical technicians (3831)	335	File clerks (4696)
225	Science technicians, n.e.c. (3832, 3833, 384, 389)	336	Records clerks (4699)
	Technicians, except health, engineering, and science		
226	Airplane pilots and navigators (825)		
227	Air traffic controllers (392)		
228	Broadcast equipment operators (393)		

1990 Census of Population occupational classification system—Continued

1990 census code	Title
	Financial records processing occupations
337	Bookkeepers, accounting, and auditing clerks (4712)
338	Payroll and timekeeping clerks (4713)
339	Billing clerks (4715)
343	Cost and rate clerks (4716)
344	Billing, posting, and calculating machine operators (4718)
	Duplicating, mail and other office machine operators
345	Duplicating machine operators (4722)
346	Mail preparing and paper handling machine operators (4723)
347	Office machine operators, n.e.c. (4729)
	Communications equipment operators
348	Telephone operators (4732)
353	Communications equipment operators, n.e.c. (4733, 4739)
	Mail and message distributing occupations
354	Postal clerks, exc. mail carriers (4742)
355	Mail carriers, postal service (4743)
356	Mail clerks, exc. postal service (4744)
357	Messengers (4745)
	Material recording, scheduling, and distributing clerks
359	Dispatchers (4751)
363	Production coordinators (4752)
364	Traffic, shipping, and receiving clerks (4753)
365	Stock and inventory clerks (4754)
366	Meter readers (4755)
368	Weighers, measurers, checkers and samplers (4756, 4757)
373	Expediters (4758)
374	Material recording, scheduling, and distributing clerks, n.e.c. (4759)
	Adjusters and investigators
375	Insurance adjusters, examiners, and investigators (4782)
376	Investigators and adjusters, except insurance (4783)
377	Eligibility clerks, social welfare (4784)
378	Bill and account collectors (4786)
	Miscellaneous administrative support occupations
379	General office clerks (463)
383	Bank tellers (4791)
384	Proofreaders (4792)
385	Data-entry keyers (4793)
386	Statistical clerks (4794)
387	Teachers' aides (4795)
389	Administrative support occupations, n.e.c. (4787, 4799)
	Service Occupations
	Private Household Occupations
403	Launderers and ironers (503)
404	Cooks, private household (504)
405	Housekeepers and butlers (505)
406	Child care workers, private household (506)
407	Private household cleaners and servants (502, 507, 509)
	Protective Service Occupations
	Supervisors, protective service occupations
413	Supervisors, firefighting and fire prevention occupations (5111)
414	Supervisors, police and detectives (5112)
415	Supervisors, guards (5113)
	Firefighting and Fire Prevention Occupations
416	Fire inspection and fire prevention occupations (5122)
417	Firefighting occupations (5123)
	Police and Detectives
418	Police and detectives, public service (5132)
423	Sheriffs, bailiffs, and other law enforcement officers (5134)
424	Correctional institution officers (5133)
	Guards
425	Crossing guards (5142)
426	Guards and police, exc. public service (5144)
427	Protective service occupations, n.e.c. (5149)
	Service Occupations, Except Protective and Household
	Food preparation and service occupations
433	Supervisors, food preparation and service occupations (5211)
434	Bartenders (5212)
435	Waiters and waitresses (5213)
436	Cooks (5214, 5215)
438	Food counter, fountain and related occupations (5216)
439	Kitchen workers, food preparation (5217)
443	Waiters'/waitresses' assistants (5218)
444	Miscellaneous food preparation occupations (5219)
	Health service occupations
445	Dental assistants (5232)
446	Health aides, except nursing (5233)
447	Nursing aides, orderlies, and attendants (5236)
	Cleaning and building service occupations, except household
448	Supervisors, cleaning and building service workers (5241)
449	Maids and housemen (5242, 5249)
453	Janitors and cleaners (5244)
454	Elevator operators (5245)
455	Pest control occupations (5246)
	Personal service occupations
456	Supervisors, personal service occupations (5251)
457	Barbers (5252)
458	Hairdressers and cosmetologists (5253)
459	Attendants, amusement and recreation facilities (5254)
461	Guides (5255)
462	Ushers (5256)
463	Public transportation attendants (5257)
464	Baggage porters and bellhops (5262)
465	Welfare service aides (5263)
466	Family child care providers (pt 5264)
467	Early childhood teacher's assistants (pt 5264)
468	Child care workers, n.e.c. (pt 5264)
469	Personal service occupations, n.e.c. (5258, 5269)
	Farming, Forestry, and Fishing Occupations
	Farm Operators and Managers
473	Farmers, except horticultural (5512-5514)
474	Horticultural specialty farmers (5515)
475	Managers, farms, except horticultural (5522-5524)
476	Managers, horticultural specialty farms (5525)
	Other Agricultural and Related Occupations
477	Supervisors, farm workers (5611)
479	Farm workers (5612-5617)
483	Marine life cultivation workers (5618)
484	Nursery workers (5619)
	Related Agricultural Occupations
485	Supervisors, related agricultural occupations (5621)
486	Groundskeepers and gardeners, except farm (5622)
487	Animal caretakers, except farm (5624)
488	Graders and sorters, agricultural products (5625)
489	Inspectors, agricultural products (5627)
	Forestry and Logging Occupations
494	Supervisors, forestry, and logging workers (571)
495	Forestry workers, except logging (572)
496	Timber cutting and logging occupations (573, 579)

1990 census code	Title
	Fishers, Hunters, and Trappers
497	Captains and other officers, fishing vessels (pt 8241)
498	Fishers (583)
499	Hunters and trappers (584)
	Precision Production, Craft, and Repair Occupations
	Mechanics and Repairers
503	Supervisors, mechanics and repairers (60)
	Mechanics and repairers, except supervisors
505	Automobile mechanics (pt 6111)
506	Automobile mechanic apprentices (pt 6111)
507	Bus, truck, and stationary engine mechanics (6112)
508	Aircraft engine mechanics (6113)
509	Small engine repairers (6114)
514	Automobile body and related repairers (6115)
515	Aircraft mechanics, exc. engine (6116)
516	Heavy equipment mechanics (6117)
517	Farm equipment mechanics (6118)
518	Industrial machinery repairers (613)
519	Machinery maintenance occupations (614)
	Electrical and electronic equipment repairers
523	Electronic repairers, communications and industrial equipment (6151, 6153, 6155)
525	Data processing equipment repairers (6154)
526	Household appliance and power tool repairers (6156)
527	Telephone line installers and repairers (6157)
529	Telephone installers and repairers (6158)
533	Miscellaneous electrical and electronic equipment repairers (6152, 6159)
534	Heating, air conditioning, and refrigeration mechanics (616)
	Miscellaneous Mechanics and Repairers
535	Camera, watch, and musical instrument repairers (6171, 6172)
536	Locksmiths and safe repairers (6173)
538	Office machine repairers (6174)
539	Mechanical controls and valve repairers (6175)
543	Elevator installers and repairers (6176)
544	Millwrights (6178)
547	Specified mechanics and repairers, n.e.c. (6177, 6179)
549	Not specified mechanics and repairers
	Construction Trades
	Supervisors, construction occupations
553	Supervisors; brickmasons, stonemasons, and tile setters (6312)
554	Supervisors, carpenters and related workers (6313)
555	Supervisors, electricians and power transmission installers (6314)
556	Supervisors; painters, paperhangers, and plasterers (6315)
557	Supervisors; plumbers, pipefitters, and steamfitters (6316)
558	Supervisors, construction, n.e.c. (6311, 6318)
	Construction trades, except supervisors
563	Brickmasons and stonemasons (pt 6412, pt 6413)
564	Brickmason and stonemason apprentices (pt 6412, pt 6413)
565	Tile setters, hard and soft (pt 6414, pt 6462)
566	Carpet installers (pt 6462)
567	Carpenters (pt 6422)
569	Carpenter apprentices (pt 6422)
573	Drywall installers (6424)
	Construction trades, except supervisors (continued)
575	Electricians (pt 6432)
576	Electrician apprentices (pt 6432)
577	Electrical power installers and repairers (6433)
579	Painters, construction and maintenance (6442)
583	Paperhangers (6443)
584	Plasterers (6444)
585	Plumbers, pipefitters, and steamfitters (pt 645)
587	Plumber, pipefitter, and steamfitter apprentices (pt 645)
588	Concrete and terrazzo finishers (6463)
589	Glaziers (6464)
593	Insulation workers (6465)
594	Paving, surfacing, and tamping equipment operators (6466)
595	Roofers (6468)
596	Sheetmetal duct installers (6472)
597	Structural metal workers (6473)
598	Drillers, earth (6474)
599	Construction trades, n.e.c. (6467, 6475, 6476, 6479)
	Extractive Occupations
613	Supervisors, extractive occupations (632)
614	Drillers, oil well (652)
615	Explosives workers (653)
616	Mining machine operators (654)
617	Mining occupations, n.e.c. (656)
	Precision Production Occupations
628	Supervisors, production occupations (67, 71)
	Precision metal working occupations
634	Tool and die makers (pt 6811)
635	Tool and die maker apprentices (pt 6811)
636	Precision assemblers, metal (6812)
637	Machinists (pt 6813)
639	Machinist apprentices (pt 6813)
643	Boilermakers (6814)
644	Precision grinders, filers, and tool sharpeners (6816)
645	Patternmakers and model makers, metal (6817)
646	Lay-out workers (6821)
647	Precious stones and metals workers (Jewelers) (6822, 6866)
649	Engravers, metal (6823)
653	Sheet metal workers (pt 6824)
654	Sheet metal worker apprentices (pt 6824)
655	Miscellaneous precision metal workers (6829)
	Precision woodworking occupations
656	Patternmakers and model makers, wood (6831)
657	Cabinet makers and bench carpenters (6832)
658	Furniture and wood finishers (6835)
659	Miscellaneous precision woodworkers (6839)
	Precision textile, apparel, and furnishings machine workers
666	Dressmakers (pt 6852, pt 7752)
667	Tailors (pt 6852)
668	Upholsterers (6853)
669	Shoe repairers (6854)
674	Miscellaneous precision apparel and fabric workers (6856, 6859, pt 7752)
	Precision workers, assorted materials
675	Hand molders and shapers, except jewelers (6861)
676	Patternmakers, lay-out workers, and cutters (6862)
677	Optical goods workers (6864, pt 7477, pt 7677)
678	Dental laboratory and medical appliance technicians (6865)
679	Bookbinders (6844)
683	Electrical and electronic equipment assemblers (6867)
684	Miscellaneous precision workers, n.e.c. (6869)
	Precision food production occupations
686	Butchers and meat cutters (6871)
687	Bakers (6872)
688	Food batchmakers (6873, 6879)

1990 Census of Population occupational classification system—Continued

1990 census code	Title
	Precision inspectors, testers, and related workers
689	Inspectors, testers, and graders (6881, 828)
693	Adjusters and calibrators (6882)
	Plant and System Operators
694	Water and sewage treatment plant operators (691)
695	Power plant operators (pt 693)
696	Stationary engineers (pt 693, 7668)
699	Miscellaneous plant and system operators (692, 694, 695, 696)
	Operators, Fabricators, and Laborers
	Machine Operators, Assemblers, and Inspectors
	Machine operators and tenders, except precision
	Metal working and plastic working machine operators
703	Lathe and turning machine set-up operators (7312)
704	Lathe and turning machine operators (7512)
705	Milling and planing machine operators (7313, 7513)
706	Punching and stamping press machine operators (7314, 7317, 7514, 7517)
707	Rolling machine operators (7316, 7516)
708	Drilling and boring machine operators (7318, 7518)
709	Grinding, abrading, buffing, and polishing machine operators (7322, 7324, 7522)
713	Forging machine operators (7319, 7519)
714	Numerical control machine operators (7326)
715	Miscellaneous metal, plastic, stone, and glass working machine operators (7329, 7529)
717	Fabricating machine operators, n.e.c. (7339, 7539)
	Metal and plastic processing machine operators
719	Molding and casting machine operators (7315, 7342, 7515, 7542)
723	Metal plating machine operators (7343, 7543)
724	Heat treating equipment operators (7344, 7544)
725	Miscellaneous metal and plastic processing machine operators (7349, 7549)
	Woodworking machine operators
726	Wood lathe, routing, and planing machine operators (7431, 7432, 7631, 7632)
727	Sawing machine operators (7433, 7633)
728	Shaping and joining machine operators (7435, 7635)
729	Nailing and tacking machine operators (7636)
733	Miscellaneous woodworking machine operators (7434, 7439, 7634, 7639)
	Printing machine operators
734	Printing press operators (7443, 7643)
735	Photoengravers and lithographers (6842, 7444, 7644)
736	Typesetters and compositors (6841, 7642)
737	Miscellaneous printing machine operators (6849, 7449, 7649)
	Textile, apparel, and furnishings machine operators
738	Winding and twisting machine operators (7451, 7651)
739	Knitting, looping, taping, and weaving machine operators (7452, 7652)
743	Textile cutting machine operators (7654)
744	Textile sewing machine operators (7655)
745	Shoe machine operators (7656)
747	Pressing machine operators (7657)
748	Laundering and dry cleaning machine operators (6855, 7658)
749	Miscellaneous textile machine operators (7459, 7659)
	Machine operators, assorted materials
753	Cementing and gluing machine operators (7661)
754	Packaging and filling machine operators (7462, 7662)
755	Extruding and forming machine operators (7463, 7663)
756	Mixing and blending machine operators (7664)
757	Separating, filtering, and clarifying machine operators (7476, 7666, 7676)
758	Compressing and compacting machine operators (7467, 7667)
759	Painting and paint spraying machine operators (7669)
763	Roasting and baking machine operators, food (7472, 7672)
764	Washing, cleaning, and pickling machine operators (7673)
765	Folding machine operators (7474, 7674)
766	Furnace, kiln, and oven operators, exc. food (7675)
768	Crushing and grinding machine operators (pt 7477, pt 7677)
769	Slicing and cutting machine operators (7478, 7678)
773	Motion picture projectionists (pt 7479)
774	Photographic process machine operators (6863, 6868, 7671)
777	Miscellaneous machine operators, n.e.c. (pt 7479, 7665, 7679)
779	Machine operators, not specified
	Fabricators, assemblers, and hand working occupations
783	Welders and cutters (7332, 7532, 7714)
784	Solderers and brazers (7333, 7533, 7717)
785	Assemblers (772, 774)
786	Hand cutting and trimming occupations (7753)
787	Hand molding, casting, and forming occupations (7754, 7755)
789	Hand painting, coating, and decorating occupations (7756)
793	Hand engraving and printing occupations (7757)
795	Miscellaneous hand working occupations (7758, 7759)
	Production inspectors, testers, samplers, and weighers
796	Production inspectors, checkers, and examiners (782, 787)
797	Production testers (783)
798	Production samplers and weighers (784)
799	Graders and sorters, exc. agricultural (785)
	Transportation and Material Moving Occupations
	Motor vehicle operators
803	Supervisors, motor vehicle operators (8111)
804	Truck drivers (8212–8214)
806	Driver-sales workers (8218)
808	Bus drivers (8215)
809	Taxicab drivers and chauffeurs (8216)
813	Parking lot attendants (874)
814	Motor transportation occupations, n.e.c. (8219)
	Transportation Occupations, Except Motor Vehicles
	Rail transportation occupations
823	Railroad conductors and yardmasters (8113)
824	Locomotive operating occupations (8232)
825	Railroad brake, signal, and switch operators (8233)
826	Rail vehicle operators, n.e.c. (8239)
	Water transportation occupations
828	Ship captains and mates, except fishing boats (pt 8241, 8242)
829	Sailors and deckhands (8243)
833	Marine engineers (8244)
834	Bridge, lock, and lighthouse tenders (8245)
	Material moving equipment operators
843	Supervisors, material moving equipment operators (812)
844	Operating engineers (8312)
845	Longshore equipment operators (8313)

1990 Census of Population occupational classification system—Continued

1990 census code	Title
848	Hoist and winch operators (8314)
849	Crane and tower operators (8315)
853	Excavating and loading machine operators (8316)
855	Grader, dozer, and scraper operators (8317)
856	Industrial truck and tractor equipment operators (8318)
859	Miscellaneous material moving equipment operators (8319)
	Handlers, equipment cleaners, helpers, and laborers
864	Supervisors, handlers, equipment cleaners, and laborers, n.e.c. (85)
865	Helpers, mechanics and repairers (863)
	Helpers, Construction and Extractive Occupations
866	Helpers, construction trades (8641-8645, 8648)
867	Helpers, surveyor (8646)
868	Helpers, extractive occupations (865)
869	Construction laborers (871)
874	Production helpers (861, 862)
	Freight, stock, and material handlers
875	Garbage collectors (8722)
876	Stevedores (8723)
877	Stock handlers and baggers (8724)
878	Machine feeders and offbearers (8725)
883	Freight, stock, and material handlers, n.e.c. (8726)
885	Garage and service station related occupations (873)
887	Vehicle washers and equipment cleaners (875)
888	Hand packers and packagers (8761)
889	Laborers, except construction (8769)
	Military Occupations[1]
903	Commissioned officers and warrant officers
904	Non-commissioned officers and other enlisted personnel
905	Military occupation, rank not specified
	Experienced Unemployed Not Classified by Occupation
909	Last worked 1984 or earlier

[1] Includes only uniquely military occupations. Other Armed Forces members are coded to civilian occupations.
The numbers in parentheses refer to the 1980 Standard Occupational Classification codes.
"Pt" means part.
"n.e.c." means not elsewhere classified.

Note

[1] The views expressed in this paper are those of the author and do not necessarily reflect the views of the U.S. Bureau of the Census or the Bureau of Labor Statistics.

The Occupational Employment Statistics Program Occupational Classification System

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Introduction

This paper describes the Occupational Employment Statistics (OES)[1] classification system, provides a comparison of this system with the Standard Occupational Classification (SOC) system,[2] and suggests how the full implementation of current initiatives in the OES program could provide valuable information to those charged with developing an occupational classification system suited to the needs of a U.S. workforce adjusting to its role in a global economy.

Description of the OES System

The OES survey system is an empirically based economy-wide occupational classification system.[3] The 744 occupations in the OES system are identified by their title as well as by a definition which describes the chief job duties. The definitions are largely based upon those found in the *Dictionary of Occupational Titles*.[4] Implicit in the definitions for some of the occupations is the skill required to perform that function.

The OES system organizes all occupations into four levels: Division, major group, minor group, and detail. Each occupation is identified by a 5-digit code. The first digit represents the division; the second the major group; the third the minor group; and the last two digits, with the preceding three, identify the detailed occupation. There are residual categories within the various levels of the system to report occupations not identified at the detail level. The complete 1993 OES structure is available upon request.[5] The following sections discuss the first two levels of the system as well as residual occupational categories. Information on minor groups can be found in the annual OES publication.[6]

Division level

The seven occupational divisions in the OES system are:

1. Managerial and administrative
2. Professional, paraprofessional, and technical
3. Sales and related
4. Clerical and administrative support
5. Service
6. Agriculture, forestry, fishing, and related
7. Production, construction, operating, maintenance, and material handling

First-line managers/supervisors are included in every division except for the managerial and administrative and the professional, paraprofessional, and technical divisions. The supervisors of managers are other managers. The professional, paraprofessional, and technical supervisors need subject matter knowledge to such an extent that they are classified with the workers they supervise.

Major group level

Highlights of the major group structure of each division are provided below.

Managerial and administrative occupations. This division is organized into three major groups. The first contains specialized occupations by function (for example, purchasing managers), and the second contains specialized occupations by industry (for example, education administrators). Both of these categories are generally at the middle-management level. When function and industry overlap, function takes precedence and is listed first in the structure. The third group, the residual group, includes workers, usually in upper management, whose duties are broader in scope.

Professional, paraprofessional, and technical occupations. This division is organized into 10 major groups. These major groups were created by combining those professional, paraprofessional, and technical occupations requiring a common body of knowledge and expertise. Unlike the SOC system, the OES classification system handles any distinctions between technical and professional workers at the minor group level rather than at the major group or division level.

The first major group is management support. The OES system, unlike the SOC, has placed this group in the professional division rather than in the managerial division. BLS believes individual management support occupations, such as accountants, are functionally closer to the professional specialties than to the management occupations.

The remaining major groups are: Engineers and related occupations; natural scientists and related workers; com-

puter, mathematical, operations research and related occupations; social scientists, and other social, recreational, and religious occupations; law and related occupations; teachers, educators, librarians, and related occupations; health practitioners, technologists, technicians, and related health occupations; selected writers, artists, entertainers, athletes, and related occupations; and other professional, paraprofessional, and technical occupations.

Sales and related occupations. The sales division is arranged into three major groups: Supervisors, services sales occupations, and merchandise and products sales occupations. Unlike the other divisions, this division does not contain a division level residual category. There is no need for one because the first group is broad and there are residual categories for the second and third major groups. Together these three groups are exhaustive of all sales workers.

Clerical and administrative support occupations. This division is organized into seven major groups. As with the other divisions, the supervisory category is first. The next major group includes industry-specific clerical occupations such as bank tellers. These two major groups are followed by general secretarial and related workers, office machine workers, communications workers, and material recording workers. The last major group is the residual category.

Service occupations. This division consists of seven major groups. The major groups are supervisory, protective service, food service, cleaning service, health service, personal service occupations, and the residual category. The cleaning group includes various building service occupations.

Agriculture, forestry, fishing, and related occupations. This division consists of three major groups. The major groups are supervisors, logging occupations, and the residual category.

Production, construction, operating, maintenance, and material handling occupations. In terms of employment, this is the largest and most diverse group of all the OES divisions. The major groups are as follows:

Supervisory
Inspecting
Repair
Construction and extraction
Precision production
Machine setting and operating
Assembling and handworking
Plant and system operation
Transportation and material handling
Helpers and laborers

The organization of this division follows the basic principles of organization of the SOC in that occupations are grouped by function (for example, inspecting, repairing, producing) and by skill requirements (for example, precision, setup, operating, helping).

A third organizing principle in many of these groups is the distinction made between machine and hand operations. In this case, hand operations include the use of hand-held power tools.

Within the large production and precision and machine groups, distinctions are made on the basis of materials worked (for example, metal/plastic, wood, textile, assorted/other). The assorted/other category includes working with combined materials as well as working with single materials, such as stone, which have not previously been specified.

Residual occupational categories

The OES classification system contains occupations that are numerically significant either in one industry, or across all industries. For occupations not meeting one of these standards, residual categories (that is, "All other . . .") have been created within most levels of the OES system. Residual categories provide for a complete accounting of all workers employed within an establishment and allow aggregating and analyzing occupational employment data at various levels of detail. Some examples of residual categories are "All other professional, paraprofessional, and technical workers" at the division level, and "All other machinery maintenance mechanics" at the detail level.

Comparison of OES with SOC

The OES system consists of slightly under 750 detailed occupations that together cover the entire wage and salary economy. The 1980 SOC had 664 detailed occupations. BLS started with the SOC detailed occupations as the base. They then added scientific and technical occupations to satisfy the needs of the National Science Foundation; added also were occupations that require specialized training that were requested by users in education. Then some of the 664 SOC occupations which generated little interest from users were collapsed to higher levels. The next section provides examples of differences between the two systems.

Specific comparisons[7]

Number of detailed occupations. The following list shows the number of detailed occupations in both the OES and SOC systems that would fall under each of the 21 SOC divisions. This table helps isolate the SOC divisions where there are large differences in the number of detailed occupations between the two systems. The division with the largest difference between the two systems is

the marketing and sales category where the SOC has 47 occupations and the OES only 12. The OES system has 17 occupations for health technicians and technologists, while the SOC has only 6.

SOC division name	SOC	OES
Executive, administrative and managerial	46	42
Engineers, surveyors, and architects	18	19
Natural scientists and mathematicians	17	20
Social scientists, social workers, religious workers, and lawyers	13	15
Teachers, librarians, and counselors	38	32
Health diagnosing and treating practitioners	6	7
Registered nurses, pharmacists, dieticians, therapists, and physicians assistants	9	11
Writers, artists, entertainers, and athletes	14	21
Health technicians and technologists	6	17
Technologists and technicians, except health	22	26
Marketing and sales	47	12
Administrative support, include clerical	66	77
Service	48	66
Agricultural, forestry, and fishing	28	*19
Mechanics and repairers	30	58
Construction and extractive	36	54
Precision production	48	68
Production working	112	115
Transportation and material moving	28	48
Handlers, equipment cleaners, helpers, and laborers	32	17
Military	NA	NA

Occupations in OES; not separate in SOC. This section shows two examples of the OES system splitting an SOC occupation into more detailed OES occupations. In each case, OES data users wanted more detailed information than was provided by the detailed SOC category. This was particularly true when a single SOC detailed occupation included multiple occupations with different skill levels and/or training requirements. BLS was able to accommodate users without creating comparability problems with the SOC. In each case, users can determine the employment total for the SOC occupation by simply summing the component OES occupations.

SOC detailed occupation, OES detailed occupations with 1990 employment level

Example 1	
SOC 3650 Radiologic technologists and technicians	
OES total employment for SOC 3650	154,257
OES 32914 Nuclear medicine technologists	10,360
OES 32917 Radiologic technicians	69,929
OES 32921 Radiologic technologists	73,968
Example 2	
SOC 3690 Health technicians, not elsewhere classified	
OES total employment for SOC 3690	420,171
OES 32508 Emergency medical technicians	89,337
OES 32923 Electroneurodiagnostic technologists	6,714
OES 2925 Cardiology technicians	12,022
OES 32926 Electrocardiograph technicians	15,813
OES 32928 Surgical technologists and technicians	38,142
OES 32999 All Other Health professionals, para- and technicians	258,143

Occupations in SOC; not separate in OES. The following are two examples of detailed SOC occupations that are not listed separately as detailed OES occupations. The employment level listed is that of the OES occupation. It is not possible to estimate the OES survey employment for the equivalent SOC components unless the components are differentiated only by industry. For example, analysts can use the OES survey estimates for sales representatives in SIC 26 (Paper and allied products) to determine the number of sales representatives in that industry.

SOC detailed occupation, OES detailed occupation, and 1990 employment level

Example 1	
OES 49008	Sales representatives, except scientific and related products or services, and retail employment = 1,161,937
SOC 4242	Sales representatives, commercial and industrial equipment and supplies
SOC 4243	Sales representatives, garments and related textile
SOC 4244	Sales representatives, motor vehicles and supplies
SOC 4245	Sales representatives; pulp, paper, and paper products
SOC 4246	Sales representatives; farm products and livestock
SOC 4249	Sales representatives; n.e.c.
Example 2	
OES 83005	Production inspectors, testers, graders, sorters, samplers, and weighers employment = 407,825
SOC 7820	Production inspectors, checkers, and graders
SOC 7830	Production testers
SOC 7840	Production samplers and weighers
SOC 7850	Graders and sorters, except agriculture
SOC 7870	Production expediters

Detailed OES occupations that are in a different division in the SOC. The following are examples of the few instances where detailed OES occupations are in different divisions in each system: *Morticians or funeral directors* are in the professional, paraprofessional, and technical division in OES and in the manager division in the SOC. OES analysts determined that because of the licensing requirements of this occupation, it belonged with the professional, paraprofessional, and technical group. *Lawn services managers* are included with managers in OES, and in the other agriculture and related workers division within the SOC. The managerial tasks performed by workers in this occupation call for it to be grouped with managers.

Theoretically, if the detailed occupations in one classification system are the same as those in another, any differences in summary levels can be resolved by going down to the most detailed level and using the same aggregation scheme to develop summary levels. By doing this, the user can alleviate comparability problems. In reality, however, users are often either unaware of differences of the composition of aggregate levels at the detailed level, or are not provided with the detailed information needed to develop accurate aggregate levels comparisons. This lack of information may cause them to draw incorrect conclusions from the data. This problem could be eliminated in the future if all classification systems are directly comparable at some level.

OES Program Initiatives with the Potential to Refine the Current OES and SOC Classification Systems

Recently, four initiatives have been undertaken in the OES program which have the potential to provide valuable information to be used as input in determining which new occupations should be added to the classification system. Feedback from OES data collection has led to two of the four new initiatives. This feedback comes from information provided on the survey form or on the telephone by the respondent. The last two initiatives involve BLS staff using existing information to paint a clearer picture of the occupational staffing patterns of establishments. The four initiatives are: a) The OES wage survey, b) the new and emerging occupations project, c) the 4-digit Standard Industrial Classification (SIC) project, and d) the size-of-establishment project. Each project will be briefly described.

The OES wage survey

BLS initiated the OES wage survey because of the inability of any current survey to provide accurate information on wages for all industries at the detailed occupation level. These are data needed to address the good jobs/bad jobs issue.[9] The OES survey was chosen as a vehicle to address this issue because it collects accurate information in a cost-effective manner for *all* occupations in the economy. Consequently, relative wage information can be obtained. Furthermore, it collects information for all States and thus OES data could provide comprehensive wage estimates. Pilot surveys conducted in 1989 and 1990 showed the feasibility of collecting such information in an economical and accurate manner through the OES survey. The survey uses an innovative data collection technique to reduce respondent burden. The survey estimates the number of persons employed in each occupation by wage range, and estimates a median and mean wage rate for each occupation.[10] The data are produced by geographic area and industry. The National Association of State Occupational Information Coordinating Committees, which directly serve over 7 million students by disseminating OES data with other information through their career information delivery systems, endorsed the OES wage survey at their national meeting in 1990. Fourteen States currently are conducting the survey. Inclusion of all States would provide invaluable data concerning good jobs and bad jobs at the national level, and information on other policy issues. It would also produce data for each State with which to identify States falling behind in the quest to transform the economy from one relying on low-wage occupations to one dominated by high-skill/high-wage occupations.

Classification impact. For classification purposes, the distribution of employees across wage ranges for each occupation may reveal, through bimodal distributions, the possibility that an OES occupation is actually two or more occupations.

The new and emerging occupations project

Respondents to the OES survey are asked to provide information concerning the number of workers employed in the occupations that are listed with their definitions on the survey form. In addition, on the last page of the form they are asked to list new and emerging occupations that are not on the survey form together with a definition and employment total. The State OES staff review the responses and forward those forms containing new occupations to BLS. BLS staff review and prepare a list of new occupations together with a composite definition of each. This year BLS provided this information to the Employment and Training Administration so their field staff could study each occupation in the field and assign a *Dictionary of Occupational Titles* code to each occupation. The results of this joint effort will be released later this year.

Classification impact. Some of these new occupations will provide early insight into new industrial activities that are in their embryonic stage. The new classification structure must be flexible enough to accommodate these new occupations.

The 4-digit SIC occupational estimates project

This project is designed to yield occupational estimates at the 4-digit SIC level. The OES survey sample is selected at the 3-digit SIC level. Estimates are developed at the 2- and 3-digit SIC levels. A great deal of heterogeneity of economic activity exists within many of the 3-digit SIC groups. When this happens it almost always translates into widely varying staffing patterns among the establishments within the 3-digit group.

There are enough sample units within most 4-digit SIC's to yield national occupational estimates. A recent look at the 4-digit industry level shows, as might be expected, that there is less volatility among the staffing pattern of establishments at this level. Studying occupational staffing patterns at this level makes it easier to detect true changes in the way establishments are staffing.

Classification impact. Detecting true changes will allow BLS to more accurately observe trends in the occupational employment levels. This increased accuracy will assist in decisions as to whether new occupations are becoming numerically significant enough to include separately in the classification structure.

Size of establishment estimates project

This project will yield industry specific occupational staffing patterns separately by size of establishment. The OES survey sample units for each 3-digit industry will be placed into one of four groups according to employ-

ment size, and occupational estimates will be prepared for each of the four groups. The data will reveal how establishments within homogeneous industries staff differently based upon employment level. Some occupations may exist only in certain size establishments. Occupations with the same title may require vastly different skill levels and the workers' job duties may be quite different, depending upon the size of the establishment. This is particularly true among managers. The International Standard Classification of Occupations developers feel so strongly about this factor relative to managers that they classify managers differently depending upon the size of the establishment.

Classification impact. OES size of establishment data would allow analysts to do the same.

Summary

In summary, the OES survey program provides information which can and should be used by the architects of a new SOC. While experts may offer different opinions on the structure and content of the new SOC, to make a sound decision, they need to look at OES together with other relevant information.

Notes

[1] For an explanation of the Occupational Employment Statistics program, see BLS Handbook of Methods, Bulletin 2414, pp. 29–31, U.S. Department of Labor, Bureau of Labor Statistics, 1992.

[2] See Standard Occupational Classification Manual (1980). U.S. Department of Commerce, Office of Federal Statistical Policy and Standards.

[3] The OES system had 1,460 detailed occupations prior to the OES implementation of the SOC in 1980. The downsizing to 744 occupations was based upon user needs and empirical evidence provided by employment levels reported in earlier OES surveys. The OES system is economy-wide, but the survey excludes self-employed workers, unpaid family workers, private household workers, and agricultural production workers.

[4] See Dictionary of Occupational Titles, 1991, U.S. Department of Labor, Employment and Training Administration.

[5] For a copy of the OES structure, contact the Bureau of Labor Statistics, Office of Employment and Unemployment Statistics, 2 Massachusetts Avenue NE., Room 4840, Washington, DC 20212-0001.

[6] See Occupational Employment in Selected Nonmanufacturing Industries, 1991. Bulletin 2417, U.S. Department of Labor, Bureau of Labor Statistics, 1993.

[7] Data in this section are OES survey data adjusted to 1990 industry totals.

[8] The OES survey excludes the agricultural production sector.

[9] Barry Bluestone and Bennett Harrison, The Great Job Machine: The Proliferation of Low Wage Employment in the U.S. Economy, December 1986. U.S. Congress, A study prepared by the Joint Economic Committee, Washington, D.C.

[10] Sandra West, Diem-Tran Kratzke, and Shail Butani. "Measures of Central Tendency for Censured Wage Data," Proceedings of the 1992 American Statistical Association.

Discussion

MARILYN MANSER: One issue that, I think, underlies this conference is the potential importance or need for some sort of uniformity or consistency among various classification systems. I think these presentations point out another need or focus that may, to some extent, conflict with that goal, and that is the fact that the purposes of the various systems may be different and that it's important to consider uses of data as we think about designing these systems.

It's not only existing uses of data that we want to consider, but potential important future needs that may not be well met by these systems.

ARDEN FORREY: I'm interested in the classification of occupations from the standpoint of health records and within the development of consensus standards for health data. I'm wondering to what extent the titles, the rubrics for various occupations, could be separated from the classification structure, because rubrics are the label by which the data are recognized and inputed into the system, and we want to have it as intuitive as possible to be as accurate as possible.

The classification systematics for the various purposes could be separated from that rubric in ways that are appropriate or most optimal for those purposes. I'm just curious to what extent the people who are developing these classification systems could engineer that separability. Can we have an understandable title or rubric that facilitates the intuitive recognition of the title whenever you're gathering this information, for whatever purpose?

We're interested in it, of course, for health records, but we want to key on the purposes for all the rest of the system and not reinvent anything new. Our problem in gathering that data is the recognizability of the title of the occupation, the job, the activity.

The underlying purposes of the various classification systems are not always intuitively understood by the people who gather data, but if there's a way those could be separated, you could gather the data and the classification could take place transparently.

MICHAEL MCELROY: I think what you're referencing is whether we could have a list of occupations that are readily understandable to people as opposed to a system. We currently have something called crosswalks which show the link among common titles across different systems. What we have found over time, and what Neal Rosenthal covers in his paper, is that there are severe weaknesses in using those crosswalks.

The problem you speak of has been addressed through these linkage systems to help the user, but, largely because of how weak some of those links are, many of us would like to see a standardized system so we wouldn't have to go through these artificial links.

ELLEN DULBERGER: I have two questions/comments. The first is for Brian MacDonald. I saw in your list of principles that you had supervisors classified separately. My question is: In an environment where the virtual office is becoming more and more common and widespread, it seems to me that people are becoming more and more responsible for managing and supervising their own activities. I wonder if, by setting up a principle whereby we try to make a distinction between supervisors and workers, we're just creating more and more confusion as time goes on.

Then the second question, also for Brian, is: When I looked at the list of principles, something that I found missing was a statement as to whether the classification system should be based on similarities of the activities that the people perform or similarities of the skills which might enable a grouping to perform a variety of different activities.

BRIAN MACDONALD: Ellen, with regard to your first question, the principle that separated supervisors from the employees they supervise: these twelve principles were the principles used in 1980, used probably in 1977 also. That doesn't mean that these principles are the ones to be used for a revised SOC. The question is very worthwhile to bring up.

I think the answer to your second question on whether it's similarities of skills or similarities of duties, differs somewhat by major division. A lot of the engineering occupations are grouped by similarities of skills, and some of the blue-collar occupations used similarities of the duties that the individuals had.

Neal Rosenthal is the only other one that I know in the room that worked on the system. Neal, maybe you can throw something in here.

NEAL ROSENTHAL: You could take nursing occupations. You have registered nurses, licensed practical nurses, and nurse aides, all doing nursing, at different skill levels. They're all grouped in different places.

Basically, our system now is an education system. It's a skill level education system, the way we group things. I think that was the homogeneity for grouping things together, more than like work. That was the basic principle that was followed in grouping.

ELLEN DULBERGER: The other question I had was for Mr. Scopp, (Bureau of the Census) and that had to do with a comment related to potential for linkage in the datasets. It seems to me that we have an opportunity, through coordination of efforts across statistical agencies, to establish exact matches in datasets where we don't currently do so.

So from the user's point of view, we wind up having to rely on inference or statistical matches rather than being able to tell exactly. A case in point would be the household survey of unemployment and the establishment survey of employment, whereby, perhaps using something like a Social Security number or an employer ID number combined with Social Security number, one could have an exact match.

That could be valuable for a variety of purposes, including understanding the differences in how employees and employers describe their jobs. Would you like to comment on that comment?

THOMAS SCOPP: I know one of the suggestions made is, at least with the SOC and the DOT, to have the linkage between the codes used, that the SOC would be part of the DOT code. Then you can make that natural link, and perhaps somehow the census code can be worked in there, too.

I think one of the biggest challenges facing this particular group is how to link the two very different uses of the data, which are the ones you alluded to, the establishment side versus the household side. Very often they are different purposes, and the different sources providing the data provide them in different ways.

That does create some problems for those of us who are trying to put that data into a usable fashion for folks like you who are trying to link other things together, too. I think that's going to be one of the major tasks that anyone here trying to put a new SOC together is going to face, to make it useful for both household sources as well as establishment sources.

JOHN PRIEBE: I think one thing I heard you asking—Could I take this individual and match him to the employer?

There has been lots of interest and a lot of work at it, but the confidentiality requirement is the big problem in trying to do that. The census ruled out trying to collect Social Security just because it might impede people responding.

Social Security is matched. It is collected in some of the current surveys, but those matches are very difficult, and there's lots of ropes to jump and hurdles to go through just to keep the confidentiality in place. So that's one of the big obstacles.

MARILYN MANSER: There clearly are obstacles. There have been in the past special cases where there have been efforts to collect information from both employees and employers, though. So it certainly is possible and perhaps desirable, if extremely costly and complex to do that sort of thing.

MALCOLM COHEN: I have a question on the Census Bureau presentation. The comment was made that there were very few changes made between the 1980 and 1990 census. This brings to bear kind of an interesting problem about what is actually done in terms of how we classify and measure in terms of what is stated and how it actually is implemented in practice.

For example, when I looked at the difference between the 1980 and 1990 census, I found a lot of changes in the area of elementary and secondary school teachers. Even though we say we're measuring elementary and secondary school teachers, apparently the way the questionnaire is developed, you don't pick up somebody who is a special education teacher.

They may identify themselves on the questionnaire as being a teacher, and then you classify them as being an elementary school teacher. Unless you really know how the coding is done, you might not be able to tell that there's been a major shift, or at least a change between how the census classifies occupations and some other system might classify occupations.

Another example: Transportation ticket and reservation agents. There is no indication at all when you look at the changes that this occupation has changed. Yet when you look at, say, CPS data from one year to the next, it appears as though it's almost doubled in size, and there's got to be something going on beyond what's listed in terms of your page of changes.

How does one know about this? When the Census Bureau puts out a new system, how do they tell users that there may be very small changes that may make very big differences?

THOMAS SCOPP: I think what you're alluding to is two different levels of change. When I mentioned there was very little change, I'm talking in terms of theoretical categories, how we, at least on paper, attempt to classify people.

What we are still going to be victims of, if you will, are the words that people choose to give us when they give us the responses, either in a census or a survey. To the extent that that changes over time, that people don't give us the detail, while in theory we have a classification system that should put them in their proper place, so to speak, if they don't give us the words, they can very often be misclassified.

I think your example of the elementary school teacher is probably the best one. There does appear, in the resulting data, that there has been an artificial increase in the numbers.

That's probably due to the fact that people, for some reason, and we don't have that reason, really—maybe because they just didn't take the time in the 1990 census to give us that detail or maybe they just didn't feel it was important or something—did not tell us specifically what kind of teacher they were.

Very often, what happens is the coder has to make an arbitrary choice. Some of the coding is done by computer. Some of the coding is done by human coders,

but they have to make a judgment, given the information they have.

There is a tendency, if no other information is given, to put people into the elementary school level where they may actually be secondary teachers or, as you mentioned, special education teachers. So if we don't have the words to know which category they should properly go into, we can make the wrong choice of categories, even though the classification system, in theory, should catch that.

I'm not sure if that helps the problem. To the extent that we see those changes in the data, we do try to show that in publications and so on, but it's hard to catch that in advance. It's hard to know in advance what people are going to say on the questionnaires.

MARY POWERS: Mary Powers, again addressed to Tom Scopp. In this discussion you talked about hoping to develop the SOC. In the kinds of academic research that I do, although I'm not sure it's academic, we're very concerned with change over time.

Maybe the more interesting question for the last two decades is, to what extent has the position of women and minorities in the labor force changed? Are we dependent upon having consistency in occupational categories? When there are major changes, you can't answer those questions.

What are we planning to do which will enable us to answer questions like that? By the year 2000 I would like to know, for example, what happened in the last 20 years.

THOMAS SCOPP: Well, that is a dilemma that, I guess, we'll have to face here, and certainly that's what happened in 1980. What Mary is referring to is that, when we redid the census classification in 1980 to model the SOC, it was very, very different from the classification system we used before, and that did wreak havoc among users who wanted to do time series; because the changes that they saw in the data were probably as much or more due to the change in the classification as in the real world of work.

So that is an important consideration. Certainly, when we come up with a new SOC for the 1990's here, that's something that we'll have to look at, try to temper our need to keep the classification system reflecting the real world but also realizing that we need to still have a link with the past to be able to measure change over time.

That's going to be a difficult task, I think, but it is certainly a factor that we have to keep in mind as we continue this conference and beyond. I agree. I think that our recommendation in John's previous paper, is that, yes, we need to have this linkage of the systems; we want them to be consistent. We want them to reflect the real world, but let's not go overboard. Let's also remember that a lot of change can be as damaging as no change at all in terms of the classification system.

NEAL ROSENTHAL: I'd like to follow up on the concern that Malcolm Cohen had in terms of looking at the census. You identified six occupations that you dropped or you added or something like that, and that's the basic change. However, somebody from BLS found 80 different occupations where there are changes made from the 1980 census to the 1990 census. Because, if you take the jobs the way the census does, the job titles that were listed under each occupation, sometimes they were switched between the 1980 census and the 1990 census, from one year to the next.

So, in effect, it's the same SOC category. It matches, but in effect you get different numbers, because some of the jobs were moved out and classified in different places. That does create a problem for longitudinal analysis, because you don't know how many people moved out and moved in. So you can't do any longitudinal analysis, even though it's the same occupation.

THOMAS SCOPP: That's correct. That's a point well taken, again different levels of looking at it. I was talking on just the categories, of the 500-odd categories, that changed. But when you get down to detailed titles, the *Dictionary of Occupational Titles* and our own index contain over 30,000 of those, some do shift from category to category, and they do affect the data.

After our census we try to put out a technical paper that gets into that level where we show the proportion of each category that actually stayed the same or moved to somewhere else, that reflects the difference in the titles, and perhaps even some of the coding and coding errors that occur from census to census.

We're hoping that we can do that again. We've done a lot of the research that would eventually go into the technical paper. I hope the budget will allow us to do that again, because I know it will be of interest, and we'll address that kind of problem you've just mentioned. But we have done that, at least in the last three or four censuses, where we show the difference between the classification system in that respect.

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Module 2. New Challenges and Alternative Approaches to Occupational Classification

Introduction

This section focuses on new challenges and alternative approaches to occupational classification. The first three papers, presented by the Economic Roundtable, Seymour Wolfbein, and Joel Popkin and Company, focus on how changes in the structure of the economy and technology affect occupations, changing user demands of occupational information, and discuss the implications for a revised SOC. All three stress the necessity of a new SOC, one that provides much more information about the skill content of jobs. The second group of papers, by Mark Loewenstein and Marilyn Manser, Daniel Krymkowski, and Bruce Tonn and Frederick Conrad, are more methodological in nature, demonstrating how techniques in economic, sociological, and psychological research, respectively, can contribute to the development of a new occupational classification system.

Future Use of the SOC

Mark Drayse
Odessa Dubinsky
Daniel Flaming
Robin Law

Economic Roundtable

Executive Summary

Objectives

This report explores future uses of the Standard Occupational Classification (SOC) to provide an organizing template for integrating national occupational classification systems and helping a broader base of users respond to important public interests such as worker productivity and empowerment. The primary assumption underlying this effort is that the design of occupational classification systems should be based on providing information needed to achieve important public goals for the workforce.

Occupational information can assist individuals who have never had a job become employed, it can help those who have lost jobs become reemployed, and it can indicate how those who are employed can become more productive. These outcomes are vital to the public interest and have direct implications for the future structure of occupational classification systems. The objective of this report is to offer a vision of the future SOC that will help policy makers, organizations, and workers achieve their shared interest in enabling individuals to find productive, satisfying jobs, as well as enabling individuals collectively, in the form of our society, to form a sustaining economy.

Methods

A primary test of the usefulness of occupational information is its power to provide a plausible, grounded account of the actual experience of workers. Just as a job should connect an individual's activities with a larger group of workers and their activities, and that in turn with the output of a product or service that is valued by a changing society, a useful description of that job should reflect significant characteristics of the worker, the activity, linked activities of other workers, and processes of change. Since the labor market is not in equilibrium, descriptions of constant and established factors in occupations offer good but only partial insight; in effect, a snapshot in time. The dynamic relationships among occupations, and between occupations and changes in demographics, production processes and markets, make it necessary to continuously incorporate fresh information into occupational classification systems.

In an effort to push beyond the boundaries of the existing system we contacted a broad range of individuals who are concerned about labor market outcomes, but are not necessarily users of current occupational classification systems, to inquire about their priorities and ask about the kind of occupational information they think is needed. Limitations of the current DOT/SOC were tested by exploring the usefulness of these systems for identifying reemployment opportunities for laid off aerospace workers. Recommendations offered in this report are based on reviewing limitations of current systems, opportunities offered by alternative classification methods, and the public interest in helping workers find good jobs.

Findings

General issues in classification. The enterprise of classifying all activity in the wage economy into a system of occupations raises several fundamental questions. Some of the questions are common to all taxonomies, whether they be of stamps, insects or occupations. All classification systems need to specify the distinguishing features that will determine inclusion or exclusion into categories. All systems require decisions about how constituent parts are to be grouped into broader categories. All systems should take into account how they are to be used to sort and organize data collected in the future. In addition, the designers of a system that deals with patterns of behavior (such as occupations) rather than recognizable material objects (such as insects) need to define the basic unit of analysis. Four conceptually different tasks in designing an occupational classification system are:

1. Selecting variables by which to define, cluster and describe occupations;
2. Defining occupations;
3. Aggregating occupations into a system of nested hierarchies; and
4. Designing the database (designating the information to be indexed to the occupational categories).

The selection of variables should begin by distinguishing between those variables used for sorting and those supplementary variables used for information. *Sorting variables* are data elements used to define and aggregate

occupations. They should comprise the stable and intrinsic features of the occupation. As the basic foundations for the classification system, they must be collected at the job analysis stage. Jobs within an occupation should have a high level of homogeneity on these variables. Typical sorting variables are skill level, and type of task performed.

Supplementary variables are data elements that are not used in classification, but that form part of the occupation description and the database of information organized by occupation. Heterogeneity within occupations is likely to be higher than for sorting variables. Supplementary variables are also more liable to change over time. Supplementary variables may be collected at the time of the job analysis, or in later surveys. Typical supplementary variables are gender composition and rate of employment growth of occupations.

Four central questions to be addressed in revising the DOT/SOC system relate to the conceptual elements of designing a classification system: selecting variables, defining occupations, aggregating occupations, and creating a database.

1. Perhaps the most fundamental choice is the selection of sorting variables for the DOT. The selection of these variables will in turn determine the possible choice of sorting variables for the SOC. Supplementary variables to be collected for inclusion in a data base organized by DOT and SOC categories also need to be selected, but this is a process that can take place once the initial design of the system is established.
2. The question of the broad number of basic units in the DOT system ("titles") should be considered a policy decision, rather than the outcome of a natural process. It should be considered in relation to the appropriate number of SOC basic units, since the SOC occupational classification (the "unit group") will represent the first level of aggregation of DOT titles. The selection of the number of SOC occupations should be made with reference to the occupational categories currently used in the OES and the Census.
3. System architecture comprises the aggregation of occupations into larger clusters. General decisions need to be made about the optimal number of *levels* and the number of *categories* within each level. The principles of aggregation need to be identified in general terms, and made operational by referring to specific sorting variables.
4. New information technology presents opportunities to create a readily accessible and comprehensive database. Decisions must be made on the level of aggregation at which information is to be collected, the form in which it is to be presented (for example, embedded in identifier codes), and how it is to be updated and maintained.

Overview of labor market trends. Significant changes have occurred in American labor markets in the last twenty years that have important implications for revising the SOC. Declining profit rates and increased foreign competition have compelled many American manufacturers to downsize their operations, seek wage concessions, close plants, and eliminate hundreds of thousands of well-paying union jobs. In many cases jobs have been merged as companies seek greater latitude in deploying workers and determining job tasks. The restructuring of corporations has forced millions to seek jobs in an unstable labor market, in which involuntary job-hopping and longer, more frequent bouts of unemployment are becoming a way of life. An increasing number of jobs are part-time or temporary and often are filled by women, who have entered the labor force in growing numbers since the 1960's. These trends have contributed to a growing polarization between relatively well-paying, secure jobs on the one hand, and relatively low-paying, insecure jobs on the other.

One of the most striking changes facing workers today is the growing "flexibility" of labor markets. Today's workers are less likely than were their parents to be associated over the long term with specific job tasks and occupations. Three types of labor market flexibility are: (1) Wage flexibility, (2) numerical flexibility, and (3) functional flexibility.

With the erosion of company and career job ladders in many occupations, workers are faced with the prospect of looking for jobs in unfamiliar places, with limited information on jobs that could use their skills, or the most profitable way in which they can upgrade their skills. These changes place great importance on using the SOC as a tool to match workers with jobs on the basis of skills transferability, rather than DOT titles alone. Workers need accurate, up-to-date knowledge about local labor market conditions, including jobs that they are qualified for, as well as jobs for which they could apply with added training.

Using the SOC for job-worker matching: A Case Study of Machine Trades Occupations in the Aircraft and Aerospace Industries. Are the families of DOT occupations grouped together in the SOC as it is currently structured useful to the large numbers of aircraft and aerospace workers who have lost their jobs because of defense cutbacks and are forced to seek work outside their area of specialization? What information provided by the DOT and SOC is most valuable for facilitating job matches? What information not currently included in the DOT and SOC would be helpful to workers? These questions are explored through: (1) A narrowly defined search conducted in an effort to identify potential reemployment

opportunities for unemployed aerospace workers in occupations that have related classifications in the DOT and SOC systems; and (2) under the assumption that one of the most important bridges between occupations is skills transferability, DOT variables for worker functions and skill level were used in a broadly defined search for clusters of occupations in which workers in the aircraft and aerospace industries might find jobs suitable to their expertise in other industries.

The narrowly defined searches attempted to create matches based on the first six digits of the DOT and on SOC and OES groups. These searches failed to identify useful skill transference paths for laid-off aerospace workers because the potential new jobs they identified were all within the same industry group, and are all experiencing the same decline in demand for workers. Broadly-based searches produced long lists of occupations that shared similar characteristics based on worker functions, GED, SVP, and related variables. These matches were intended to create groups of occupations on the basis of potential skills transferability. However, there is no way to distinguish between high-quality matches and poor matches solely on the basis of generic variables such as GED and SVP. The DOT is structured to support highly specific matches between workers and jobs with the same, or closely related, DOT titles. Attempts to conduct broader searches on the basis of skills-related variables cast such a wide net that their value is limited. What is needed for this purpose is specific skills information that captures the substantive complexity of jobs, and can be used to connect occupations that use similar skills.

Priorities for the future SOC. A wide net was cast to draw on the expertise and opinions of individuals in diverse positions with different approaches to the potential use of an occupational classification system. Despite some diversity in origin, they share a remarkably strong consensus on the necessary information that an occupational classification system should contain, and the major problems currently experienced by users. There appears to be fairly broad support for changes that transform the DOT/SOC in the direction recommended in this report.

Priority rankings for public interest that should be supported by occupational information are developed based on the assessment of the research team as well as priorities expressed by respondents from whom information was obtained. The most important public interests are identified as: helping individuals with barriers to employment obtain jobs, helping displaced workers become reemployed, identifying essential competencies needed for employment, and making optimal matches between jobs and workers. This was followed in importance by: identifying career advancement opportunities for workers, helping students, and workers make good career choices, providing current labor market information, making labor market projections, and integrating occupational data with other information about the work force. Following this in importance were public interests associated with historical, international and medical research.

Information elements currently used, and proposed for future use, in classifying occupations are rated according to their feasibility and overlaid in table 11 on the public interests they support. There is significant variation in the number and combinations of information elements needed to support different public interests. A broad array of information is needed to help individuals overcome barriers to employment or to make good matches between job seekers and job openings. In comparison, relatively few information elements are needed to support research activities. The feasibility of providing information elements was ranked in three tiers: if it is already being (or could readily be) done in a satisfactory manner it was given a high feasibility rating, if methodologies appear available for generating the information it was given a medium feasibility rating, and the one case in which it appeared infeasible to develop a satisfactory data gathering methodology (personal qualities required for occupations) was given a low feasibility rating.

The overlay of feasibility and priority rankings in table 12 creates four principal clusters of information elements. These clusters offer a possible set of priorities for the future SOC. Since there are not any information elements that support only threshold priority public interests (those elements supporting lower priorities such as research also support higher priorities such as helping displaced workers), and excluding the information element dealing with personal qualities needed for jobs because of infeasibility, all other information elements fall into one of the four possible combinations created by high and medium feasibility and high and medium priority.

The first cluster of occupational information elements that are both high priority and high feasibility should be the foundation of the future SOC. These include existing information elements identifying occupation specific skills and industries in which occupations are used, and new or revised information elements to identify educational requirements and necessary diplomas, licenses and certificates, as well as to enable linkage of occupational information with census and labor market data.

Most of the information elements in the second cluster that are medium priority but high feasibility (i.e., can be done without great cost) are already part of the DOT. These should remain part of the new DOT/SOC and include: contextual information about work settings, extent to which occupations are subject to use as part time or temporary labor, requirements for physical capabilities and motor skills, and environmental conditions.

The third cluster of high priority, medium feasibility elements includes two types of skill related information that are the subject of much discussion and interest: identification of competencies required for specific occupa-

tions and developing a generic skill vocabulary that can be used to identify the same skills in different occupational settings. Inclusion of these information elements, particularly generic skill descriptions, is a major undertaking requiring significant funding to develop and carry out new information gathering methodologies. It is important to allocate the necessary resources because this information will support critical public interests as well as help structure the future DOT/SOC.

The fourth cluster includes four information elements that are important but also require development of new information gathering methodologies. These include: Extending the capabilities of a generic skill vocabulary so as to enable identification of different skill levels within a common skill area, identifying the degree of autonomy and work variation in occupations, improving current capabilities for linking aptitudes and interests with occupations, and maintaining a census of occupations by industry. Each of these types of information supports important public interests in the work force. This information is needed for the future DOT/SOC but if a strategy of phased implementation is required, these information gathering efforts might be initiated after other efforts are underway.

Implications

Core recommendations:

Structure:	Integrate the DOT and SOC into a single system that is technically and conceptually compatible.
Content:	Classify occupations on the basis of skills, authority, and work fields.
Uses:	Simplify the connection between occupational information, labor market information, and social and demographic information by using the revised SOC unit group as the main occupational unit.

Recommendations on structure:

- Combine the DOT and SOC so they share a common classification structure. Retain the DOT title as the most detailed occupational unit. For the next level of aggregation, cluster similar DOT titles into new groups equivalent to the SOC unit group. Use a single structure for further levels of aggregation.
- Combine DOT and SOC operations for data collection, maintenance, and publication.
- Define the SOC basic occupational unit (unit group) by specific variables (descriptor items) rather than only in terms of its component DOT titles.
- Distinguish between sorting variables (to be used in defining occupations) and supplementary variables (to be part of a database) for both the DOT titles and the SOC basic units.
- Reduce the number of DOT titles. The number of SOC unit group occupations and the number of DOT titles to be included in a revised system should be the outcome of both strategic choice and objective evidence.
- Set the broad parameters for the total number of SOC unit groups with reference to the data needs and data collection capacities of the Census Bureau and the OES. Consider also the total number of categories in ISCO–88 and the Canadian systems.
- Base the definitions of occupations on consistent principles.

Recommendations on content:

- Use a combination of broad skill levels, authority, and work fields to construct a matrix of occupations.
- Consider the societal goals identified in Table 1 (in Part 1) in selecting variables.
- In choosing variables, incorporate the criticisms and suggestions generated by the various critical reviews of the occupational classification system in recent years.
- Use sound theoretical principles in selecting variables and rating schemes, incorporating state-of-the-art cognitive science, psychometric testing and evaluation.
- Consider demands for customized aggregations when selecting SOC descriptor items.
- Ensure that information elements included in a SOC database meet the major needs of workers seeking placement. Incorporate a wide range of skills-related information, including indicators of cognitive requirements, complexity, responsibility, training requirements, and specific hiring criteria.
- Review the measurements of skill and consider the relationship between actual and objective skill requirements.
- Include measures of occupation-specific and transferable skills in the sorting variables for the DOT and the SOC. Ensure that the SOC basic occupational units contain information elements that facilitate skill transferability.

Recommendations on uses:

- Collect occupational and labor market information using the same occupational classification system. Coordinate the occupational structure used in the OES and US Census of Industries and Occupations to generate a single set of occupations, obviating the need for crosswalks.
- Contribute to public policy through research using occupational information that is reliable, comprehensive, consistent, clearly defined, and comparable with other data.
- Incorporate recent developments in geographical information collection, management, and analysis in the form of GIS.
- Use existing sources of labor market information in geographic analysis.

- Use opportunities for linking occupational information from multiple sources.
- Ensure that occupational classifications used in *worker-based* information sources (such as population census) match (as much as possible) *job-based* sources (such as data from firms).
- Design aggregation of occupations into broad clusters (which will be relied upon where occupational data must be aggregated to protect confidentiality in fine geographic scales) to meet the needs of all users.
- Consider current sources of worker or job data with a spatial component as potential participants in a future labor market database forming part of a GIS analysis.
- Integrate wage and claims data with job service occupational coding data.
- Integrate occupational matrices, public employment service job listings and ES–202 data.

Recommendations on implementation:

- Collect occupational information through a combination of surveys, interviews, job observation, and research.
- Design a sampling methodology for the new SOC that corrects the sampling biases of the DOT. Base the sample design on the sectoral and geographical distribution of industries and occupations.
- Collect local labor market information for worker-job matching and occupational and labor market research.
- Coordinate efforts by national, state, regional, and local agencies to collect and disseminate labor market information.
- Use census data on employment levels by occupation to select redundant and obsolete DOT titles for elimination.
- Reduce the number of DOT titles by performing a computerized analysis of DOT occupational descriptions and ratings to identify titles to be merged.
- Respond to potential "should-be" users of the DOT/SOC as well as actual users.
- Design a database that is comprehensive and accessible.
- Update and revise the SOC on a regular basis, in order to maintain its currency and usefulness to workers, career planners, researchers, and policy makers.
- Strengthen linkages with institutions and individuals engaged in labor market projections, educational planning, and occupational research so that they provide information to, as well as receive information from, the national system.
- Incorporate more user-friendly methods of data presentation.

Introduction

This report explores future uses of the Standard Occupational Classification (SOC) that would provide an organizing template for integrating national occupational classification systems and helping a broader base of users respond to important public interests such as worker productivity and empowerment. The primary assumption underlying this effort is that the design of occupational classification systems should be based on providing information needed to achieve important public goals.

Over the past 50 years, occupational analysts have created a rich and credible body of information that may well be the most intellectually rigorous and substantive resource for understanding the nation's workforce. Yet the tools of occupational analysis are understood and used by a relatively small group of individuals, and this field lacks the excitement that one might expect would be associated with a subject that is at the heart of the nation's domestic agenda. Occupational information can assist individuals who have never had a job become employed, it can help those who have lost jobs become reemployed, and it can indicate how those who are employed can become more productive. These outcomes are vital to the public interest and have direct implications for the future structure of occupational classification systems.

The wealth of detailed information in occupational classification systems offers no intrinsic logic about how it should be organized. Given the lack of an integrated theory of cognitive functions in the social sciences, there is no clear overview of the human attributes being mapped by descriptions of worker activities and skills. Occupational information is made more diffuse by the lack of a uniform vocabulary that could be used to describe specific worker skills in multiple settings. And the manner in which information about jobs is bundled into occupational units is eclectic in that occupations are narrowly defined in the manufacturing sector but broadly defined in the service sector.

This wealth of information cries out for well conceived organizing principles based on important public interests that should be supported by occupational information. At the same time, advances in information technology have made it possible to integrate occupational information with geographic and social information, and labor market data describing the experiences of specific worker groups. The opportunity exists to move beyond a system that produces labor market statistics to create an integrated system that offers strategic insights into dynamic functions of the entire labor market.

In an effort to push beyond the boundaries of the existing system we contacted a broad range of individuals who are concerned about labor market outcomes, but are not necessarily users of current occupational classification systems, to inquire about their priorities and ask about the kind of occupational information they think is needed. Limitations of the current DOT/SOC system were tested by exploring the usefulness of these systems for identifying reemployment opportunities for laid off aerospace workers. Recommendations offered in this re-

port are based on reviewing limitations of current systems, opportunities offered by alternative classification methods, and the public interest in helping workers find good jobs.

Part I. Identifying Issues

Purposes for Which Occupational Information is Needed

Jobs in a continuously emerging economy

The labor market can be viewed as an evolving ecosystem.[1] Industries and occupations form a highly interconnected web that is dynamic and unstable. This web of workplace activities can undergo bursts of evolutionary change as well as extinction events, just like biological ecosystems. For example, when an industrial sector such as defense manufacturing goes into rapid decline, some of the subnetworks of technologies and firms that depended upon it disintegrate. Workers who have been jettisoned must find their way in a job market emerging out of a stagnating and declining industry giving way to something yet unformed. As new markets emerge, whole new networks of goods, services and jobs begin to grow, filling niches that had been occupied by work and products of the previous era.

Occupational information needs to reflect crucial details about how actual jobs evolve, grow or decline, and are molded by changes in industry, technology, and the workforce. Workplace requirements for skills, activities and interrelationships out of which responsibilities of an individual worker emerge also account for the bundling together of specific tasks into jobs and the identification of crucial skills. If occupational information fails to provide these dynamic, "real life" insights it is likely to be ineffective because it then offers only narrow and static delineations of labor market events. Changes in occupational structures emerge from constant adjustments and readjustments in industry and population. An understanding of the workplace as a complex system of interrelated occupations is essential for analyzing and developing programs to deal with emerging, dynamic labor market changes.

A primary test of the usefulness of occupational information is its power to provide a plausible, grounded account of the actual experience of workers. Just as a job should connect an individual's activities with a larger group of workers and their activities, and that in turn with the output of a product or service that is valued by a changing society, a useful description of that job should reflect significant characteristics of the worker, the activity, linked activities of other workers, and processes of change. Since the labor market is not in equilibrium, descriptions of constant and established factors in occupations offer good but only partial insight; in effect, a snapshot in time. The dynamic relationships among occupations, and between occupations and changes in demographics, production processes and markets, make it necessary to continuously incorporate fresh information into occupational classification systems.

Occupations emerge from interrelated work activities. Over time, some activities may be added, omitted, or transferred from one occupation to another. Yet while some forces change the character of occupations, other forces (not the least of which is the worker) give occupations resilience, coherence and continuity. The workers, whose time and effort produce something of value, imprint the logic of their experience on the way they organize their activities, as does the organization that employs them. The organizing principles of an occupation incorporate the learning of those who do the job, as well as of the employer for whom the job is done. Even though the component activities of a job may be simple, the worker integrates these activities through more complex initiatives that the worker is responsible, at least in part, for crafting.

The continuously emerging behavior of workers seeking mutual accommodation and self consistency in a changing economy creates meaning beyond the sum of specific activities in an occupation. Learning and adaption in the workplace provide a measure of stability between brittle rigidity on one extreme and turbulent free fall on the other. This learning and adaption leads to occupational structures that are increasingly complex. Workplaces where the organization of tasks is ever-open and ever-changing may well offer the best prospects for economic competitiveness, even though this requires continuous and often painful adjustments by both workers and organizations.

Information about occupations, therefore, will be most useful if it is based on continuous observation and open-eyed acceptance of change rather than anticipation of equilibrium. Occupations are shaped by processes of coadaption and accommodation with skills clustered in related occupations, changing technologies, and changing markets within a continuously emerging, interlocking global economy.

Workforce outcomes that should be assisted by occupational information

Occupational information should help policy makers, organizations, and workers achieve their shared interest in enabling individuals to find productive, satisfying jobs, as well as enabling individuals collectively, in the form of our society, to form a sustaining economy. National goals concerning employment straddle unusually divergent objectives. One has been to provide a job that would support a decent quality of life for every worker, another has been to furnish a crucial commodity required by businesses. One perspective focuses on the needs of indi-

viduals, the other on a large-scale flow of transactions in which the quarter of a million individuals who may be seeking jobs at any given time in a labor market area are routed to meet the needs of local employers. Caught between these two perspectives, labor market programs and information have often failed to encompass either the human qualities and needs of job seekers or the wealth-creating aspirations of businesses. This context may account for the value-neutral, highly technical approach that has been characteristic of information gathered about jobs for occupational classification purposes. As a whole, national occupational classification programs have reflected a high level of rigor and objectivity, but the information produced through these efforts has been used by a relatively small, and seemingly shrinking, constituency.

During the more than 50 years that the United States has had national occupational information programs there have been extraordinary transformations in the workplace: large influxes of immigrants from Europe, Asia, and Central and South America have been absorbed; the economy has shifted from being rural and agricultural to being urban and industrial, and now urban and service providing; women have entered the workforce in large numbers; equal economic opportunity for individuals has become a firmly established national goal; durable goods manufacturing sectors such as primary metals have flourished and declined while multiple generations of technologies have transformed the way in which work is done; "restructuring" brought on by economic globalization has contributed to experimentation with work organization, growth of nonunion shops, and part-time work as part of efforts to improve competitiveness, profit and cost control; and the nature of work has become increasingly complex and the rate at which jobs change increasingly rapid. Workers affected by each of these historic developments have distinctive demographic and social attributes and yet, as is shown in table 1, much of the social information that would help explain causation and change in the labor market cannot readily be connected with occupational information about workers.

Societal interests in workforce outcomes are less polarized than they were in the 1930's when work began on the *Dictionary of Occupational Titles*. It has become possible and desirable to gather information about workers and jobs that more specifically addresses outcomes for workers that are important to the public. These outcomes include:

Workforce entry and reentry. Occupational information should be useful for helping individuals facing barriers to employment in becoming permanent members of the workforce. These include new entrants to the labor market, individuals who have been long-term welfare recipients, or who have physical or mental limitations, or who have been incarcerated. Over the past decade and a half, public sector budget constraints as well as shifts in public sentiment have made it increasingly difficult for socially dependent individuals to have any means of income maintenance other than unsubsidized employment. It is, therefore, increasingly important to have occupational information that will help individuals with limited or no skills and work experience to find jobs in which their abilities and interests can be strengthened and used to best advantage, to enable them to become economically self sufficient. It is also important that occupational information offer concrete descriptions of what workers experience and do in specific occupations so that job seekers can obtain some practical understanding of the actual activities in which they must be or become competent.

Reemployment. Occupational information should facilitate the connection of workers with employers requiring their skills and abilities by identifying as many occupations as possible that require skills similar to those used in the worker's previous job(s). It should be possible to identify occupations for which the job seeker is likely to be qualified through both skill commonalities among occupations as well as through actual mobility of other workers from the same occupation into new occupations (National Research Council, 1980).

Career ladders. Occupational information should identify career ladders available to workers in specific occupations. This information could be provided by identifying better paying or more responsible occupations to which workers from specific occupations can progress. It could also be provided by identifying specific areas in and means by which workers can improve existing skills in order to become qualified for more advanced occupations.

Competency identification. Occupational information can strengthen the bridge between work and education by identifying essential competencies for jobs, as well as those competencies that are in demand in specific occupational areas. This information can be used to improve the content, quality, and value of vocational training as well as to help workers match their skills with new jobs. In addition to employers, workers could be an important source of information about critical skills in their own occupations. Information might be gathered from workers through annual surveys incorporating some of the methodology used by the military services to obtain information from officers and enlisted personnel about critical skills in each military occupation.

Optimal job matches. Competitive pressures from foreign manufacturers and the increasing prominence of younger, less educated workers among labor market entrants have stimulated national concern about the need for an adequately qualified workforce. The core issue is that the United States cannot maintain its standard of living by competing in a globalized economy based on the cost

of its workers, but it may be able to do so based on the productivity of its workers. Efforts are being made to raise educational standards in the United States. It is also important to use broad-based information about occupational requirements to support career decisions and job referrals at the level of the individual worker in order to make optimal matches between the aptitudes, traits, interests, and skills of workers and the requirements of specific occupations. The workforce can become more competitive by using occupational information to help individuals find jobs in which their unique qualifications are most in demand. Most public-sector job placement programs now mainly seek minimal matches between job seekers who want an income and employers who want workers, rather than optimal matches in which the attributes of the worker and job are matched based on greatest mutual benefit.

Worker empowerment. Job turnover and use of outside contract workers in many industry sectors means that large numbers of workers must search more frequently for new jobs, and have less job stability or tenure. Most noncollege bound youth receive little or no assistance in making the transition from school to work. Occupational information should empower youths entering the workforce and adults making job or career changes to make choices that serve their best interests in terms of job stability, work satisfaction, career advancement, and income. This information should include descriptions of the degree of autonomy and work variation within occupations, and whether occupations tend to be intrinsic (core staff) or extrinsic (contract workers) to organizations. Occupational information systems should also recognize workers as stake holders and information sources regarding the occupations that they hold.

National comparability of work. A common frame of reference that facilitates ready integration of occupational information collected by public entities and provides a useful guide to occupational classification systems within organizations is essential to both public- and private-sector understanding and application of labor market information about the workforce. National occupational classification systems are at best a secondary resource for most businesses in the development of classification systems for their workers. And empirical information where gathered by businesses to identify worker abilities that predict success in specific occupations is not fed back into national occupational databases. A unified national system of occupational information that is rich in information about skills, abilities, and traits required for occupations could be of special assistance to organizations seeking to manage structural change and effectively deploy workers. If organizational classification systems that are comparable with the national system resulted from such adaptation, information that would update and expand national classification information could be made available.

International comparability of work. In an increasingly globalized economy, in which jobs move from one country to another, it is important that occupational information enable comparison of workforce skills and deployment with that of other countries. In the near term, with the possible implementation of the North American Free Trade Agreement, it is important to be able to compare the skills and activities used to make specific products in the United States with those used by workers in Mexico and Canada to make the same or similar products.

Management of change. In a dynamic labor market the most critical aspect of an occupation may well be the areas in which it is changing. Change may occur in the form of new skill requirements, altered working conditions, or increasing or decreasing demand. Information about changing skill requirements, for example, may be used to help displaced workers enter a new occupation in which a skill they possess is in short supply. It is also important to identify changing patterns of job mobility and emerging barriers to mobility. This requires "real time" information about the manner in which the occupational structure of the work force is changing, rather than infrequent "snapshots" of a labor market that is assumed to be in equilibrium. The utility of information about changes in occupations is enhanced if it is linked to the underlying causes of change, whether this be driven by altered demographics, technologies, industries, or markets.

Research. Occupational information should support efforts to understand the labor market and to achieve desired outcomes for workers. Research activities that it should support might include:

a. *Labor market dynamics*—"What kinds of jobs tend to be open to workers with particular sorts of experience? Which jobs are filled by those who have previously worked elsewhere, which are filled by those just entering the labor force, and which are filled only by promotion from within an establishment? To what extent do sex, age, or race continue to be barriers to occupational opportunities, and are such barriers concentrated in particular sectors of the labor force?" (National Research Council, 1980: 230)

b. *Employment projections*—occupational classifications should capture the groupings in which demand for workers is likely to change so as to enable salient projections of occupational growth and decline.

c. *Compatibility with social statistics*—efforts should be made to investigate the merger of occupational data with social statistics, such as census information, to understand the labor market experience, status and expectations of specific social groups. It should also be possible

to link information about worker activities, traits, and skills with social information about workers.

d. *Historical understanding*—occupational information should provide continuity or bridges in information to make it possible to study occupational trends over time.

e. *Medical research*—occupational information should make it possible to identify workers who have been exposed to particular kinds of physical demands, work environments, and materials. It should also identify the industries using such occupations.

f. *Social mobility*—occupational data is used in social research as a measure of social status and also to investigate intergenerational social mobility by comparing children's income and status with that of their parents.

g. *Public accessibility*—there is a need to investigate methodologies, means of presentation and formats for making the SOC system and data useful to and usable by the individual job seeker, including students, new entrants, and reentrants.

Table 1. Public interests in the workforce and occupational classification information

PUBLIC INTEREST	CLASSIFICATION INFORMATION	CURRENT AVAILABILITY	FEASIBILITY
1. Help people with barriers to employment get jobs	• Educational requirements	• Available from DOT	• Feasible; now available
	• Diplomas, licenses and certificates required	• Not available	• Feasible through adding a question to classification surveys
	• Crucial competencies needed to make applicants employer-acceptable	• Mostly not available	• Feasible; extra effort required to prioritize job skills
	• Personal qualities required	• Not available	• Difficult to do in a way that is reliable, standardized, and respects the dignity of workers
	• Physical capabilities and motor skills needed	• Available from DOT	• Feasible; now available
	• Aptitudes and interests associated with occupations	• Partially available	• Feasible; work is needed to improve reliability
	• Contextual information about what is experienced and done in terms of activities, work setting, demands	• Mostly available from DOT and Occupational Outlook Handbook	• Feasible; now available
	• Environmental conditions associated with occupations	• Available from DOT	• Feasible; now available
	• Classification system that can be linked with databases showing social characteristics by occupation	• Mostly not available	• Feasible through linkage with Census data
2. Help displaced workers transfer their skills to new jobs	• Education requirements of old, and potential new, occupations	• Available from DOT	• Feasible; now available
	• Diplomas, licenses and certificates required	• Not available	• Feasible; see above
	• Crucial competencies	• Mostly not available	• Feasible; see above
	• Occupation-specific skills and knowledge (e.g., types of machinery mastered, materials used, problem-solved, etc.)	• Partially available from DOT	• Feasible; requires cognitive descriptors for skilled jobs
	• Requirements of old, and potential new, occupations in terms of generic/cross functional skills	• Not available	• Feasible; extra effort required to collect Cognitive Task Analysis or General Work Activity information
	• Required physical capabilities and motor skills	• Available from DOT	• Feasible; provided by DOT
	• Aptitudes and interests	• Partially available	• Feasible; see above
	• Industries in which occupations are found	• Available from OES and DOT	• Feasible; now available
	• Classification system linked with labor market databases	• Partially available but not used	• Feasible through linkage with Employment Service data
3. Identify career advancement opportunities for workers	• Education requirements of old, and potential new, occupations	• Available from DOT	• Feasible; now available
	• Diplomas, licenses and certificates required	• Not available	• Feasible; see above
	• Crucial competencies	• Mostly not available	• Feasible; see above
	• Generic/cross functional skills	• Not available	• Feasible; see above
	• Skill level distinctions between different occupations	• Not available for skilled occupations	• Feasible, requires generic skill categories as above
	• Degree of autonomy and work variation	• Not available	• Feasible; requires job rating scales that do not now exist
	• Use of part time or temporary labor	• Not available	• Feasible; requires job rating scales that do not now exist, and information may be industry-specific
	• Industries in which occupations are found	• Available from DOT	• Feasible; now available
	• Labor market data bases showing outcomes by occupation	• Partially available but not used	• Feasible; see above

Table 1. Public interests in the workforce and occupational classification information—Continued

PUBLIC INTEREST	CLASSIFICATION INFORMATION	CURRENT AVAILABILITY	FEASIBILITY
4. Identify essential competencies (i.e., skill clusters) needed for specific jobs	• Crucial competencies	• Not available	• Feasible; see above
	• Occupation-specific skills and knowledge	• Partially available from DOT	• Feasible; see above
	• Personal qualities that are required	• Not available	• Difficult; see above
	• Required physical capabilities and motor skills	• Available from DOT	• Feasible; now available
	• Degree of autonomy and work variation	• Not available	• Feasible; see above
5. Help students and workers make job and career choices that serve their best interests	• Education requirements of old, and potential new, occupations	• Available from DOT	• Feasible; now available
	• Diplomas, licenses and certificates required	• Not available	• Feasible; see above
	• Crucial competencies	• Mostly not available	• Feasible; see above
	• Required physical capabilities and motor skills	• Available from DOT	• Feasible; now available
	• Aptitudes and interests	• Partially available	• Feasible; see above
	• Contextual information about work settings	• Mostly available	• Feasible; now available
	• Degree of autonomy and work variation	• Not available	• Feasible; see above
	• Use of part time or temporary labor	• Not available	• Feasible; see above
	• Environmental conditions associated with occupations	• Available from DOT	• Feasible; now available
	• Labor market databases showing outcomes by occupation	• Partially available but not used	• Feasible; see above
6. Make optimal matches between workers and jobs	• Education requirements of old, and potential new, occupations	• Available from DOT	• Feasible; now available
	• Diplomas, licenses and certificates required	• Not available	• Feasible; see above
	• Crucial competencies	• Mostly not available	• Feasible; see above
	• Occupation-specific skills and knowledge	• Partially available from DOT	• Feasible; see above
	• Generic/cross functional skills	• Not available	• Feasible; see above
	• Skill level distinctions between different occupations	• Not available	• Feasible; see above
	• Required physical capabilities and motor skills	• Available from DOT	• Feasible; now available
	• Aptitudes and interests	• Partially available	• Feasible; see above
	• Contextual information about work settings	• Mostly available	• Feasible; see above
	• Environmental conditions associated with occupations	• Available from DOT	• Feasible; now available
	• Industries in which occupations are found	• Available from DOT	• Feasible; now available
7. Provide current labor market information	• Generic/cross functional skills	• Not available	• Feasible; see above
	• Skill level distinctions between different occupations	• Not available	• Feasible; see above
	• Industries in which occupations are found	• Available from DOT	• Feasible; now available
	• Census of occupations by industry	• Available for OES, not DOT	• Feasible; census of employment by DOT needed to link classification and industry data
	• Labor market databases showing outcomes by occupation	• Partially available but not used	• Feasible; see above
8. Labor market projections	• Generic/cross functional skills	• Not available	• Feasible; see above
	• Skill level distinctions between different occupations	• Not available	• Feasible; see above
	• Industries in which occupations are found	• Available from DOT	• Feasible; now available
	• Census of occupations by industry	• Available for OES, not DOT	• Feasible; see above
9. Integration of occupational and social information	• Generic/cross functional skills	• Not available	• Feasible; see above
	• Skill level distinctions between different occupations	• Not available	• Feasible; see above
	• Industries in which occupations are found	• Available from DOT	• Feasible; now available
	• Census of occupations by industry	• Available for OES, not DOT	• Feasible; see above
	• Labor market databases showing outcomes by occupation	• Partially available but not used	• Feasible; see above
10. Historical analysis of occupational trends	• Industries in which occupations are found	• Available from DOT	• Feasible; now available
	• Census of occupations by industry	• Available for OES, not DOT	• Feasible; see above
	• Labor market databases showing outcomes by occupation	• Partially available but not used	• Feasible; see above
11. International comparisons of occupational composition	• Education requirements of old, and potential new, occupations	• Available from DOT	• Feasible; now available
	• Diplomas, licenses and certificates required	• Not available	• Feasible; see above
	• Industries in which occupations are found	• Available from DOT	• Feasible; now available
	• Labor market data bases showing outcomes by occupation	• Partially available but not used	• Feasible; see above

Table 1. Public interests in the workforce and occupational classification information—Continued

PUBLIC INTEREST	CLASSIFICATION INFORMATION	CURRENT AVAILABILITY	FEASIBILITY
12. Medical research into occupational related illness and injuries	• Required physical capabilities and motor skills	• Available from DOT	• Feasible; now available
	• Environmental conditions associated with occupations	• Available from DOT	• Feasible; now available
	• Industries in which occupations are found	• Available from DOT	• Feasible; now available
	• Labor market databases showing outcomes by occupation	• Partially available but not used	• Feasible; see above
	• Linkage of occupational and social (i.e., Census) information	• Partially available but not used	• Feasible; see above

Conclusion

There is general compatibility among objectives in the preceding list of societal interests that are affected by the design of occupational classification systems. With several significant exceptions, it is feasible to provide the types of classification information needed to support analysis and programs related to these public interests.

Redesign of the SOC and other national occupational classification systems to increase their usefulness for supporting publicly desired outcomes for the workforce must also take into account the history and context of occupational classification in the United States. The next section recounts the history of the SOC. It is followed by sections examining national labor market trends and system constraints affecting the redesign of the SOC.

Historical and Institutional Context of the SOC

Background

The first Standard Occupational Classification (SOC) system for general use in classifying occupational data was developed, beginning in 1966, on the recommendation of the Interagency Committee on Occupational Classification. The establishment of a standardized classification system, and its publication in 1977, was to meet a long-felt need to develop a bridge between the occupational classification system used in the 1940 Census and that used by the U.S. Employment Service to classify operating statistics. It built on a prior publication titled, *Convertibility List of Occupations with Conversion Tables and Industrial Classification for Reports from Individuals*, that had been developed by a joint committee of the Bureau of the Budget and the American Statistical Association. This publication had been made obsolete by modifications to the Census classification system, and the issuance of the third edition of the *Dictionary of Occupational Titles* (DOT).

The DOT was developed as a dictionary, paralleling other taxonomies that list items in an orderly fashion. The original DOT listed its contents alphabetically, changing only to aggregations or clusters of occupations based on discerned relationships in later editions. The first edition contained some 17,500 concise definitions of occupations; each occupation was a group title of similar jobs. A five-digit coding system was designed and individual codes were assigned to each title. The coding system was used to denote whether the occupations were skilled, semi-skilled, or unskilled.

By the third edition, issued in 1965, these designations were eliminated, and a new classification and coding system was installed based on the nature of work performed and worker requirements. The fourth edition, issued in 1977, contained over 2,100 new occupational definitions and modifications of several thousand definitions used in the earlier editions. The 1991 edition is an update of the 1977 edition. Its publication was the outcome of the efforts of the National Occupational Network's focus on the study of selected industries "in order to document the jobs that have undergone the most significant changes" in the past 15 years. The SOC, however, was not updated to include the new and added occupations.

The necessity for reconciliation between the two major classification systems (the Census and the DOT) remained, and became increasingly important as national legislation created increased demand for occupational data on a more comparable basis.

The 1977 publication of the SOC incorporated advice and counsel from other government agencies, professional organizations, labor unions, business associations, and other interested parties on group definitions, occupational content of groups, and applicability of the structure to the classification and analysis of occupational statistics. In addition, the *International Standard Classification of Occupations*, the Canadian *Classification and Dictionary of Occupations*, and the British *Classification of Occupations and Directory of Occupational Titles* were major references.

The major purpose of the system was to "maximize the analytical utility of statistics on labor force, employment, income, and other occupational data collected for a variety of purposes by a variety of users." (U.S. Department of Commerce, 1977). The users were encouraged to "use the SOC for collecting occupational data, planning occupational education and training programs, planning occupational research and analysis, planning placement services, studying mobility of workers, and related activities dealing with occupational statistics." Its

primary purpose at the time was for statistical programs. There was no evidence of socio-economic or labor market information considerations or application. The 1980 edition, in its preface, noted that the system was "designed for use in statistical analysis and presentation of data about occupations. It was not developed for any particular programmatic use." (United States Department of Commerce, 1980: 4). In effect, the developers of the SOC deliberately limited the use of the SOC to statistical application only. While the original plan was to publish a revision of the SOC after a period of "approximately 5 years," federal agency users requested an early resolution of the problems identified with the first effort. It was hoped and expected that if corrections were made quickly, major new systems would not require revision later in the 1980's. Another revision was scheduled to start in 1986 and be completed in 1988. This revision was not undertaken.

No ongoing job-site research was conducted to construct either of the SOC publications, but the DOT, on which it was based, was the result of continuing field research by the Occupational Analysis Field Center staffs, under the direction of the U.S. Employment Service. These centers conducted some 75,000 on-site analyses to verify or revise the occupational definitions that were aggregated for the SOC publications in 1977 and 1980.

Current role

Revisions of the 1980 edition were "designed to enable users to make evaluations at very broad levels of occupational detail, . . . to allow users to evaluate relationships between occupational and other demographic characteristics, and to evaluate occupations in small geographic areas." (U.S. Department of Commerce, 1980: 3). One of the first stated uses of the second edition was to be its incorporation in the published 1980 Census reports.

Applications actually made included the use of the SOC (or an equivalent classification) for collection of information by CETA programs; by all states in the Occupational Information Coordinating Committee program in the preparation and publication of data and reports (under the aegis and command of the National Office of the OICC); and in particular, by the Occupational Employment Statistics (OES), which collects structural occupational information from a very large sample of employers. In 1983 the OES classification system was revised to mirror more closely the SOC system. It was designed by the Bureau of Labor Statistics, which continues oversight of the program. Subsequent OES data gathering has continued to be based on the 1980 SOC system, with some revisions and exceptions.

The OES, and its application in state-generated occupation and industry matrix projections of employment, along with reports and computerized occupational counseling and labor market reports prepared by state OICC's, present the major known utilization of the SOC system. Although government agencies are encouraged to use the SOC to promote consistency in the presentation of data, this directive may be met by the use of crosswalks. In consequence, the mandate has been met for the most part by the use of crosswalks connecting Census data, OES data, and the SOC categories. The SOC aggregations were used in modified versions in both the 1980 and the 1990 censuses. The Current Population Survey also uses the SOC groupings.

Because the SOC aggregations are frequently used in employment projections, it is possible that in some instances the occupation groupings are used for determining vocational training programs; experience, however, indicates that many training programs have been directed toward more specific occupations, even to the job level. Training facilities more recently have been encouraged to train at a broader level, although the tendency to offer programs leading to specific jobs for specific industries, and even individual firms, remains strong in many areas.

Problems involved in the use of the SOC system

As indicated, the SOC was not based on field research nor was any effort made to do other than aggregate the DOT titles into reasonable and logical groups. Its major purpose, as noted, was for statistical analysis of occupational data, which in itself discouraged users who were interested in such hands-on activities as recruitment, counseling, job matching, training, and job search. Since the SOC was never linked to data collection, there was little opportunity for some of the inevitable problems to be identified and dealt with in the beginning. In other words, the system did not undergo a process of "debugging" through use in the field.

The SOC had, therefore, an elite audience, and was mostly unknown and unused except by the "inner circle" group to which it was presented. There is no record of any special effort at advertising or publicizing its publication, nor evidence of training manuals or supervised training of potential users.

The lack of dynamism in the occupational classification system, as evidenced by the lag between the 1980 SOC and the supplements to the DOT, as well as the inability to incorporate the 1991 DOT revisions, also worked against the wider use of the SOC. After having made a decision to use the system, OES staffs were able to update, revise and augment the coding as warranted by the continuous generation of occupational information through the employer surveys.

Compatibility problems

While both the 1980 and 1990 censuses used the SOC categories, actual reconciliation with Census data has been slow because of the major problems inherent in trying to match establishment and household-based data, in collection, accuracy, standardization of titles and definitions, and comprehension of inquiry. Employer- or es-

tablishment-based data are usually collected through a formal, government-issued document, that in itself gives credence to the purpose and ultimate use of the data. Also provided is a confidentiality guarantee. The data are reviewed, questioned if there are doubts about legitimacy, and recoded by trained and occupation-knowledgeable staff before use in reports. Household-based data, while also collected on an official document, except in the case of the Monthly Report of the Labor Force (which may be obtained through personal phone calls), do not carry the same imprimatur to the householder, who may neither understand nor care about the questionnaire, and may not even be able to entitle his or her own occupation correctly.

While the household questionnaires are ultimately coded by staff of the data collecting agency, the margin for error is very large, because of time and occupational knowledge limitations. Also, the well-known tendency to either over- or under-rate one's job must be taken into consideration when determining the accuracy of household-based data. Therefore, reconciliation of Census-type and OES-type data, even if occupational title groups are compatible, may be difficult and result in a high degree of error.

Influence and confluence of international occupational classification systems

When reviewing the history of the SOC, time and attention should be given to a major publication of international influence on occupational classification systems, and on the flow of form and content as well as context into systems in many countries. This is the *International Standard Classification of Occupations,* (ISCO), a publication of the International Labour Organization. The history of this manual goes back to international discussions in the 1920's of the need for a standard system of job titles and occupational classifications and to the subsequent adoption of a provisional classification system in 1949 by the Seventh International Conference of Labor Statisticians. The first edition of ISCO came out in 1958, with revisions in 1968, 1980, and 1988.

The ISCO–88 was described as "an independent tool for describing and presenting information on occupations in a manner which makes international comparison possible. It can also serve as a model for developing or revising a national occupational classification." (International Labour Organization, 1988: back cover). Its purpose has been put to good use by a number of countries, as has the U.S. *Dictionary of Occupational Titles.*

Most countries' versions of an occupational classification system were developed between the 1950's and the early 1970's. National systems were set up to provide a basis for development and production of statistical data, usually for the benefit of a census of population and to be an aid to employment service operations. In the latter instance, several countries have developed substantial systems in addition to dictionary-type systems, directed toward client services such as counseling, job matching, education curricula planning, job information such as skill requirements, and geographic and industrial location of jobs.

According to Wootton, "although national classification structures vary due to industrial, cultural and other differences, they are all either based on or derived from work performed; that is, they emanate from a country's job structures rather than an individual's professed capabilities" (1993: 8). One major difference that should be noted is that the United States has a very weak national program linking school and work. Review of several of the papers submitted to APDOT by other countries shows that all countries' programs were directed primarily and especially toward the collection of a wide variety of statistical data for administration and planning of special programs and for research.

All countries reported similar problems and deficiencies in early trials, and many are continuing to make valiant efforts to overcome them; almost all also report financing difficulties as well as underuse. However, actual damage or loss to users because of identified deficiencies such as system format, size, number of titles, and complexity is impossible to specify or measure.

Differences in approach between the SOC and some of the European systems may be found in such examples as France's practical system to trace transition from school to work and provide simple, easy materials for new workers (mostly students) to learn about jobs and what is needed to qualify for them. The French grouping system uses "emploi-type," translated and well-understood in France as typical work situations, or a group of tasks offering common characteristics that are to be performed by the same individual. The French have also developed ROME (Repertoire Operationnel de Metiers et Emplois) for placement assistance. It is described as "a pragmatic and practical tool" directed toward determining and utilizing skills, competencies, and levels of qualification in the preparation for and employability in the chosen work area. The *Occupational Outlook Handbook* is a similar U.S. product, but is not as "user-friendly" as the French.

The Netherlands' program distinguishes between basic occupational classification groupings, such as those found in the SOC, and systems that contain occupational information, such as training requirements, and skill transferability. In Holland, these programs are developed relatively independently.

Canada's newest National Occupational Classification taxonomy is focussed on "within-groups skill transferability and movement among occupations." Canada has had a vast and continuing history of developing and producing innovative occupational information programs, dictionaries, and methodologies for obtaining and processing occupational information.

The trend in most countries, according to their own reports, is toward the acceptance of the fact that many jobs contain similar core elements in terms of the competencies that are required of workers, and that key issues are the identification and incorporation of the purpose and outcome of work activity in their occupational information output. The movement, obviously, is toward the use of skill transferability as the main principle of occupational classification, and away from the historic "task" attachments.

Since even the definition of "skills" is subject to question, there will be a host of problems to overcome in each change of any classification system, probably outweighing those encountered in the construction of the original DOT-type listings of occupations by name (titles), number (code), and a definition.

Conclusion

The historical context in which the DOT and SOC were created and maintained, and the relationships that have developed between the institutions using and maintaining these systems (and related information such as the Census) form a structure that both constrains future development and poses opportunities for change. But these aspects are not the only structural constraints. In addition, there are important elements of the contemporary political context that shape future possibilities. There is at present evidence of a strong interest in improving the situation of workers and the performance of the workforce through education and retraining. This creates a hospitable environment for new government initiatives in revising the occupation information database. However, deep-seated concern with the level of overall government spending will set severe limits on the resources available for this issue.

Another important context for revision to the occupational information system is the world of work, and trends in the labor market. Several significant changes in the sphere of employment have meant that an occupational information system must meet new challenges. First, the inevitable obsolescence of some jobs and the emergence of new ones makes a revision imperative. Second, the heightened rate of change in technology and labor allocation has meant that workers today face a situation of greater flux. They are more likely to face frequent turnover, insecure employment tenure, the obsolescence of craft skills, and the phasing out of their occupational specialization. In this situation, information about occupations, and about the possibilities of skill transfer and mobility into new jobs becomes pressing. Since workers will be facing these upheavals largely on their own (without, for example, government-funded transition programs), a system that is user-friendly and accessible could be of significant assistance in helping workers find their way. The dimensions of this context are explored in more detail in the next section.

Overview of Labor Market Trends

Introduction

Significant changes have occurred in American labor markets in the last 20 years that have important implications for revising the SOC. Declining profit rates and increased foreign competition have compelled many American manufacturers to downsize their operations, seek wage concessions, close plants, and eliminate hundreds of thousands of well-paying union jobs. In many cases jobs have been merged as companies seek greater latitude in deploying workers and determining job tasks. The restructuring of corporations has forced millions to seek jobs in an unstable labor market, in which involuntary job-hopping and longer, more frequent bouts of unemployment are becoming a way of life. Many workers are forced to find poorly-paid jobs in the growing service industries, in which cashiers, janitors, and security guards are emerging as fast-growing occupations. The growth and spread of information technology have created new occupations while contributing to the decline of others. An increasing number of jobs are part-time or temporary and often are filled by women, who have entered the labor force in growing numbers since the 1960's. These trends have contributed to a growing polarization between relatively well-paying, secure jobs on the one hand, and relatively low-paying, insecure jobs on the other.

Any attempts to assist workers in the labor market must take into account the ongoing restructuring of jobs and occupations, and the problems and challenges this creates for workers. The SOC should be adaptable to a changing economy, not only for the sake of accurately reflecting the division of labor, but to facilitate job searches, training, and career planning. This need is more urgent in a time of structural economic change, in which the organization of work and patterns of hiring, promotion, and career development are transformed, forcing many workers to seek jobs outside of familiar channels.

Labor market flexibility

One of the most striking changes facing workers today is the growing "flexibility" of labor markets. Today's workers are less likely than were their parents to be associated over the long term with specific job tasks and occupations. Three types of labor market flexibility are: (1) Wage flexibility, (2) numerical flexibility, and (3) functional flexibility.

Wage flexibility is a product of increased managerial control over wage determination. This is evident in union as well as nonunion firms. Unions have been pressured into making wage concessions, including freezes and cutbacks, in numerous industries. Pattern bargaining has been all but eliminated, resulting in greater geographical variation in wages. In nonunion firms, most workers have little choice but to accept the given wage. (In other words, workers may exercise their power of "exit" by leaving a job, but they have greatly reduced "voice"

in negotiating the conditions of the employment relation). Firms also may exercise wage flexibility by outsourcing work to nonunion firms, and by relocating work to nonunion locations.

Numerical flexibility refers to the increased use of part-time and temporary workers, as well as layoffs and recalls, to reduce labor costs by adjusting labor supply to fluctuations in labor demand.[2] Part-timers and temporary workers are usually not eligible for employee benefits. The percentage of part-time workers in the U.S. labor force grew from 15.5 percent in 1969 to 18.4 percent in 1988 (Economic Policy Institute, 1991: 136). Between 1973 and 1989 the number of workers employed by temporary help agencies or employment agencies increased from 256,000 (0.3 percent of total employment) to 1,351,000 (1.2 percent of total employment). Numerical flexibility is associated with high rates of worker turnover and, concurrently, weak job security (Economic Policy Institute, 1991: 136, 146).

Functional flexibility is a product of employers' attempts to eliminate strict job definitions and increase their ability to redeploy workers in response to changing demands of production. Whereas numerical flexibility is typically a response to fluctuations in demand for an establishment's product or service, functional flexibility is often an attempt to cope with nonstandardized, fragmented markets for goods and services. Sometimes work teams are created in which workers divide up tasks among themselves, rather than performing the same task over and over again. The "multitasking" of workers breaks down discrete occupational categories that, in the manufacturing sector, reflected the highly detailed division of labor created by management and unions in the postwar era.

Technological change and labor markets

In most industries, firms have introduced automated machinery, computers and telecommunications to increase productivity. In the process, jobs are created and destroyed, and some traditional skills are made obsolete while new skills are required. A striking example of technological change in the workplace has been the computer revolution in the printing industry. Since the 1970's, linotype machines have been replaced wholesale by computers to set up and produce printed pages. As a result, over 7,600 highly-skilled composing room jobs were lost between 1970 and 1983, a 53-percent decrease (Wallace, 1989: 376).

There has been an inconclusive debate in academic circles regarding the overall impact of technological change on employment growth and job quality. Some subscribe to Daniel Bell's optimistic thesis in *The Coming of Postindustrial Society* (1973) that technological change will improve job quality and create new jobs. Others, echoing Braverman's *Labor and Monopoly Capital* (1974), counter that technological change deskills jobs and increases unemployment. Whether or not the net effect of technological change is job upgrading and creation or deskilling and destruction, it is clear that both processes are occurring simultaneously. While the information revolution has created a demand for computer programmers, systems analysts, and workers who can apply information technology, it has also contributed to the elimination of relatively well-paying middle-management and production jobs. The industries producing information technology, such as electronics, are characterized by two-tier workforces, including skilled scientists, engineers, and technical workers as well as low-wage assembly workers.

Demographic trends

In recent decades women have entered the paid workforce in growing numbers. In 1970, the labor participation rate of women between the ages of 25 and 44 was 48 percent; by 1985, 71 percent of all women in the same age groups were in the wage labor force (Christopherson, 1989). The vast majority of women workers are employed in lower-tier jobs, particularly in service and retail establishments. In many corporations clerical workers have been relegated to "pink ghetto" back offices where they perform routine keyboard entry operations under constant electronic supervision (Nelson, 1986). Women often work on a part-time or temporary basis, in an attempt to maintain or supplement family income while coping with demands of raising children and running a household.

Immigrant workers play an increasingly important role in low-wage labor markets in major metropolitan centers, such as New York and Los Angeles (Sassen, 1991). Industries as diverse as apparel, cleaning services, furniture manufacturing, hotels, and fast-food restaurants are major employers of immigrant workers, many of whom are undocumented. Together with women, immigrants tend to occupy the most unstable segments of the labor market, characterized by nonunion workplaces, poor working conditions, low wages, and high turnover rates. The availability of a large supply of immigrant workers may encourage some employers to compete on the basis of a low-wage workforce, rather than try to increase worker skills. Immigrant women are in an especially vulnerable position in the labor market, many of them working in sweatshop-like conditions in garment shops, or as domestics and cleaners.

Labor market polarization

As a result of the above trends, there is ample evidence of a trend towards increasing labor market polarization. Between 1977 and 1990, the average family income of the top fifth of the labor force increased by 33.2 percent, compared with a 9.5-percent decline in the average family income of the bottom fifth. Income accruing to capital (rent, dividends, interest) increased by 66.2 percent between 1979 and 1989. Meanwhile, the number of workers earning wages below the poverty line increased from

25.7 percent to 31.5 percent of the workforce between 1979 and 1987 (Economic Policy Institute, 1990, pp. 25, 31, 82).

Income and wage polarization are directly related to the restructuring of labor markets. Numerical and wage flexibility are explicit attempts to reduce wages and job security. Functional flexibility may contribute to stagnant wages if higher-wage production jobs are collapsed into broader categories at lower pay. Current job growth is greatest in high-wage and low-wage jobs. Top-level managerial, administrative, and professional jobs have continued to grow for several reasons, including the increased importance of centralized control functions in the global economy and requirements for workers who can apply information technology (Sassen, 1991; Katz, 1992–93). Jobs paying average salaries, such as middle management and unionized production jobs, have fallen precipitously, due to corporate restructuring and technological change. Low-wage, nonunion jobs have also grown, fueled among other things by the sectoral shift of employment into service industries which are characterized by two-tier wage structures.

The trends are highlighted by Bureau of Labor Statistics projections of employment change by occupation group between 1988 and 2000. According to these estimates, the fastest growing occupations between 1988 and 2000 will be relatively high-skill occupations connected with health services and computers, including radiologic technicians, physical therapists, and computer programmers. The occupations with the greatest job growth include a mix of high-wage and low-wage occupations, such as janitors and cleaners, cashiers, registered nurses, and general managers and top executives (BLS, 1990: 59).

Implications for the SOC

Corporate restructuring, technological change, and union decline have all contributed to increased labor market flexibility and the change or elimination of many well-paying occupations, especially in manufacturing organizations. The rapidly changing labor market has made many DOT definitions inaccurate and, in some cases, obsolete. New jobs and occupations have been created by changing technologies and the growth of diverse service industries. The SOC should be revised to capture the changing occupational division of labor, in order to provide researchers and policy makers with timely information on labor market conditions, and to help match workers with jobs.

Together with labor market information (for example, employment by occupation, wages), a revised SOC could describe strengths and weaknesses in the economy with respect to goals of developing worker skills in a high-wage economy. This revised system could then help to pinpoint skills shortages, making it possible to direct worker training and career counseling efforts to fill these gaps. Information could also be gathered regarding the underutilization of existing worker skills, due to the extensive growth of low-skill, low-wage jobs relative to high-skill, high-wage jobs. In this case public policymakers, unions, and others could work to encourage the development of employment opportunities using these skills.

It is not enough to call for the development of worker skills in the absence of concerted efforts to improve job quality and create sufficient demand for skilled workers. Among other actions, this requires a strengthening of labor laws to help rather than hinder union organizing. Also, training programs need to be connected with real employment opportunities. Training for jobs that may not exist upon completion of the training program may do much more harm than good. Such training, often carried on in the absence of good labor market information, is expensive, using up resources better applied to job development, and is disheartening to workers who have been led to expect better. The SOC, constantly updated with labor market data, and conscientiously applied, could help prevent ill-considered training.

The need for public information to facilitate job search, worker training, and career planning is greater today than at any time in the postwar era. The DOT reflects a period when American manufacturing was preeminent in the global economy, wages and incomes were growing, and millions of Americans were employed in secure, career-oriented jobs that allowed them to enjoy middle class lifestyles. Job changes commonly occurred within well-defined career ladders, through seniority-based promotions. In times of recession, workers might be laid off for several months, but would receive unemployment benefits until they were recalled in the next economic upturn. Today, however, many workers outside of the professional, technical, and managerial ranks occupy jobs with lower wages, limited security, and less guarantee of promotion. Workers may be forced to change jobs and occupations if they are laid off from companies downsizing their workforce or closing operations altogether. With the erosion of company and career job ladders in many occupations, workers are faced with the prospect of looking for jobs in unfamiliar places, with limited information on jobs that could use their skills, or the most profitable way in which they can upgrade their skills.

These changes place great importance on using the SOC as a tool to match workers with jobs on the basis of skills transferability, rather than DOT titles alone. Workers need accurate, up-to-date knowledge about local labor market conditions, including jobs that they are qualified for, as well as jobs which they could apply for with added training and/or education. To meet these needs, the basis upon which occupations are classified should be evaluated. Changing labor market conditions have reduced the usefulness of the detailed, task-based

DOT titles in matching workers with jobs. There may be few if any jobs available in a specific DOT occupation, particularly if the occupation is tied to a declining or restructuring industry. If occupations are classified on the basis of skills rather than specific tasks, connections may be made on the basis of skills transferability, opening up job possibilities for workers beyond their current occupation. These issues are addressed in the next section.

Classification Issues

General issues in classification

The enterprise of classifying all activity in the wage economy into a system of occupations raises several fundamental questions. Some of the questions are common to all taxonomies, whether they be of stamps, insects or occupations. All classification systems need to specify the distinguishing features that will determine inclusion or exclusion into categories. All systems require decisions about how constituent parts are to be grouped into broader categories. All systems should take into account how they are to be used to sort and organize data collected in the future. In addition, the designers of a system that deals with patterns of behavior (such as occupations) rather than recognizable material objects (such as insects) need to define the basic unit of analysis.

Consequently, we can distinguish four conceptually different tasks in designing an occupational classification system. They are:

1. Selecting variables by which to define, cluster and describe occupations;
2. Defining occupations;
3. Aggregating occupations into a system of nested hierarchies; and
4. Designing the database (designating the information to be indexed to the occupational categories).

Selecting variables

In the present DOT system, each occupation is assigned a score for over 70 variables, including worker functions, training times, aptitudes, temperaments, physical demands, environmental conditions, work fields, and the area of materials, products, services and subject matter. The scoring or values set for some of these variables have been subjected to question over the years, especially because of design bias toward manufacturing, and lack of review and updating of some variables. The rating distribution of some variables also indicates that some potential scores are rarely assigned, calling into question their usefulness (National Research Council 1980, p. 176).

The reliability of the ratings was found to be only moderately consistent among different raters, and was generally lower for service occupations (National Research Council 1980). Reliability of results was also affected by job analysis methodology. The sample of jobs analyzed was small and unscientifically selected; nearly two-thirds of occupations in the fourth edition DOT were based on observations of fewer than three jobs (National Research Council, 1980, p. 10), and some were based on no site visits at all. Establishments of the same industry were generally selected from the same region, and were sometimes chosen for their proximity to the job analyst's field office; also, small firms tended to be avoided. In assigning scores, analysts used a notion of a "typical" establishment, developed from their own experience. Many scores are based on observations dating to the 1950's. Given these problems, the scores on many variables are suggestive rather than conclusive descriptions.

The final report submitted by APDOT (1993) presents an extensive list of possible types of classification information to be included in the DOT database, ranging from labor market trends to worker personality traits. However, the issues of relative importance of variables and feasibility of collecting information remain to be addressed. The selection of variables should begin by distinguishing between those variables used for sorting and those supplementary variables used for information.

Sorting variables are data elements used to define and aggregate occupations. They should comprise the stable and intrinsic features of the occupation. As the basic foundations for the classification system, they must be collected at the job analysis stage. Jobs within an occupation should have a high level of homogeneity on these variables. Typical sorting variables are skill level and type of task performed.

Supplementary variables are data elements that are not used in classification, but that form part of the occupation description and the database of information organized by occupation. Heterogeneity within occupations is likely to be higher than for sorting variables. Supplementary variables are also more liable to change over time. Supplementary variables may be collected at the time of the job analysis, or in later surveys. A typical example of the former is a measure of working conditions; examples of the latter include gender composition and rate of employment growth of occupations.

In the present DOT/SOC system, virtually all the publicly available information linked to DOT categories takes the *form* of a sorting variable, although not every variable is actually used to distinguish occupations. The huge size of the DOT precludes its use in most information-gathering exercises; hence most of the available information on DOT occupations is collected in job analysis and presented as a definitive generalization about all (or most) jobs in that occupation. However, if the occupation is fairly widely distributed among industries and types of firms, there will be considerable diversity among the jobs. Hence generalizations applied to all jobs within the occupation are only accurate for *some* variables (those vari-

ables actually used to define occupations); for others, "typical" ratings may conceal considerable heterogeneity.

In contrast to the DOT, the published SOC does not provide any information by sorting variables. Although the SOC aggregations are derived from clusters of DOT occupations (titles), the basis for aggregating is not made explicit, and the SOC manual does not characterize the occupations in any way apart from their component DOT titles. Users must examine the DOT descriptions and listings for component titles to determine those variables that have similar ratings. To describe an SOC occupation in terms of required education, for example, requires a considered judgement based on the range of GED scores in the constituent DOT occupations, which often vary considerably. However, population and labor market data (using Bureau of Census and OES systems) can be assigned to SOC categories, providing an extensive set of publicly available supplementary variables for the SOC.

This disparity in the form of information (by sorting variable or supplementary variable) available at the two levels of the DOT/SOC system is one of the central problems of the system as currently organized. The reliability of the DOT would be improved if some of the variables rated by information collected during job analysis (but not intrinsic features of the job) were instead rated on the results of larger and more representative surveys. In turn, the usefulness of the SOC would be enhanced if the basic occupational unit was described in terms of the sorting variables (scores on DOT variables) actually used to define it. This would make explicit the assumptions used in grouping DOT titles together to form a SOC occupation, and would simplify the analysis of labor market and population data.

This analysis leads to a conceptualization of the issues involved in better integrating the SOC and DOT with the revised set of variables. If we construct a matrix with sorting variables and supplementary variables along one side, and the DOT and SOC along the other, four potential issues emerge. Which sorting variables should be used to define and aggregate the DOT occupations? Which variables are more appropriately assigned as supplementary variables attached to the DOT basic occupational unit? Can the relationship between the DOT and the SOC be revised so that the SOC is defined in terms of some sorting variables, and if so, which variables? And finally, which supplementary variables should be attached to the SOC basic occupation (the unit group in current terminology)?

Defining an occupation

Occupations are not fully discrete natural phenomenon that present themselves unproblematically to the observer to be labelled. Instead, in the contemporary U.S., the social and technical division of labor produces "jobs" (bundles of tasks performed consistently over time by the same person in the same setting). The concept of *occupation* is then abstracted by evaluating shared characteristics of a number of jobs deemed to be similar.[3] The validity of this definition depends on a similar division of labor being enforced in different establishments and being maintained with some stability over time. Historically, there has been some degree of shared agreement on the definition of occupations, but this is the result of social practices, rather than any inherent integrity of the occupation. Professional occupations are particularly well-defined by the institutions and social practices developed to certify and represent members. Occupations covered by collective bargaining agreements negotiated by unions have also been well-defined, as the agreements typically specified tasks, conditions of work, and materials handled.

We can identify two approaches to defining occupations, the "bottom-up" approach and the "top-down" approach. The "bottom-up" approach adopted by the DOT is an attempt to conclusively identify and define discrete occupations in the economy through intensive job analysis. These occupational definitions in the dictionary can be used as building blocks and grouped into larger aggregations (as in the SOC). But any attempt to organize the range of jobs into a comprehensive dictionary of mutually exclusive, authoritatively defined occupations is subject to intrinsic problems. The tension between the demand for specificity (leading to ever-more detailed definitions, ending in the ultimate class of an occupation with only one job) conflicts with the demand for abstraction (leading to the grouping of dissimilar jobs). A significant problem in the DOT is *inconsistency* in the resolution of this tension. The methodology of job analysis (field work organized by industry) has meant that occupations in some industries (especially manufacturing) are more finely delineated than in others. It has also been claimed that jobs held by women, office jobs, and higher skill jobs have been less well-defined.

Historically, the DOT has tended toward ever-greater specificity, producing an unwieldy and expanding list of occupations, with relatively little attention to linkages and families of jobs. However, the advantage of the bottom-up, dictionary approach is that the comprehensive list of distinct occupations with associated supplementary variables may be used very effectively as a database, where individuals can manipulate, aggregate, and classify occupations according to their own needs.

The "top-down" approach devotes the greatest effort to developing a system of broad categories encompassing all economic activity, and then works toward successively more detailed levels. In this system, the definition of an occupation is not crucial, since it is only one of a range of abstractions of human behavior, culminating in the most detailed case (one specific position or job). The top-down approach produces a systematic map of the economy, with successively more detailed levels of occupational information. However, the desire to enforce

a consistent and rationally derived pattern on the structure of the classification system may obscure real and important differences among branches. Since every aggregation involves a loss of information, the choices about which variables to use when aggregating are very important. Different users will have different priorities, and the overall usefulness of the system will depend on the extent to which it retains the information considered most essential by primary users. Top-down systems are usually developed to deal with labor market or industrial information. The SOC was developed as a top-down system. A conceptual structure was developed, occupations were defined and described, and DOT titles were then grouped together on the basis of those definitions. Yet in many ways the SOC was unable to establish a well-supported independent internal structure. A cursory examination of the occupational categories suggests several cases where the range of unit groups defined appears to have been dictated by the range of existing DOT titles, rather than by an attempt to impose consistency.

In both approaches, the number of basic units (occupations) is in large part a strategic choice rather than a naturally emerging outcome of analysis. The basis for defining a DOT occupation is similarity in the kind of work performed, measured initially by common work objectives and work field, and secondarily by factors such as similarity of tasks, level of skill, and responsibility involved. In deciding whether a set of jobs would be defined as a single occupation, "analysts used no single criterion" (National Research Council, 1980, p. 144). The decision is based on informed judgement (albeit based on limited fieldwork) rather than the application of an explicit rule. However, the most important variables used in the definition (the "sorting variables" in our terminology) appear to be the relationship to Data, People, and Things, and the measures of education and training. Analysts were encouraged to avoid a range of over 3 points in one occupation in the Data/People/Things measures, and to avoid a variation of more than one level (rarely, two) in the GED scores.

The long-standing focus within the DOT system on manufacturing jobs has led to a pronounced imbalance in the occupational definitions. One analysis found that 55.8 percent of all the DOT occupations account for only 14 percent of 1988 U.S. employment (Frugoli, 1992). In other words, 86 percent of all jobs in the economy (including the fastest growing jobs) were described by fewer than half of the DOT titles. This suggests that the effort required to maintain the level of detail for the other half may be misplaced. Over 40 percent of the DOT titles are low-skilled occupations, requiring three months or less of specific preparation. Many investigations of the DOT system have concluded that the number of jobs defined could be reduced with little loss of information (Frugoli, 1992; National Research Council 1980; APDOT 1993).

The SOC is organized using the same principle as the DOT, namely sorting by kind of work performed. The smallest abstraction is the unit group, which is not defined but comprises a list of DOT occupational titles. The DOT titles are clustered on the basis of kind of work, with reference also to skill, education, training, and certification (if warranted), and field of industry (if relevant). Supervisors are identified separately from the workers they oversee; helpers are also distinguished separately.

As stated above, there is no indication in the SOC manual of the actual aggregation principles on which DOT titles were clustered into unit groups, or the principles by which those unit groups were determined. Ideally, some key variables would have been examined to ensure homogeneity along certain dimensions within SOC occupations. However, without published information, users do not know which variables were examined. The problem in the DOT of inconsistent levels of specificity in defining occupations in different industries appears to have influenced the definition of unit groups in the SOC. An example chosen at random illustrates this point. The SOC Minor group 144 contains three unit groups: Purchasing Agents and Buyers for Farm Products; Buyers, Wholesale and Retail Trade, Except Farm Products; and Purchasing Agents and Buyers, not elsewhere classified (U.S. Department of Commerce, 1980, p. 47). There are five DOT titles relating to purchasing agents for farm products, but only two (Buyer and Assistant Buyer) for nonfarm products (and nine in the n.e.c. category). This suggests that there may be some inconsistency in the DOT approach to buyers in different industries, and that this inconsistency is simply imported into the SOC, resulting in a distinction between farm and non-farm products that may be inconsequential compared to other potential distinctions.

One of the major problems with the SOC occupational definition derives from its construction from DOT titles. Since there are no empirical data on the relative share within a SOC occupation of each component DOT title, there is no reliable way of characterizing the SOC in terms of DOT variables where the scores on variables differ among the component titles. This makes it particularly difficult to link labor market information (usually collected with SOC-equivalents) to job characteristics identified for the DOT. This is especially true with respect to the measures of skill.

To address this problem, several solutions may be proposed.

1. Surveys could be conducted to produce estimates of the relative percentage of the national workforce in each DOT title within a SOC occupation. This would not require any change in the structure of the DOT or SOC, but it is a massive undertaking,

and would need constant and consistent updating and adjustment for local conditions.

2. The SOC occupations themselves could be rated on some variables, using the same process of informed judgement as the DOT ratings, along with some empirical data (such as an indication of relative share). This would be somewhat more difficult than for the DOT, since SOC occupations incorporate more diversity, especially those groupings of "not elsewhere classified" occupations.
3. The clustering of DOT titles into SOC occupations could be reorganized so that scores on the most important variables are consistent within an SOC occupation. In other words, selected variables linked to the DOT titles could operate as "sorting variables" for the SOC unit groups. By a simple mechanical sorting process, new SOC unit groups could be generated with internal homogeneity along certain variables. Considerable adjustments would be required to ensure that the groupings generated met other criteria for acceptability. However, this provides a direct and effective way of linking the wealth of information collected in the DOT to the SOC unit groups.

Since the definition of a DOT occupation is based on informed judgement by job analysts, rather than on the implementation of a consistent principle (presence or absence of defining variables), the DOT list is only one of a possible range of lists that could be derived using various methods and standards regarding diversity within the basic occupational unit. A central question for the revision of the system, which is discussed later in the report, is the approximate number of occupations to include in a revised DOT. The appropriate number of basic occupations in a revised SOC is also at issue, but that will depend to a greater degree on the demands of related systems such as the OES and the Bureau of the Census.

Aggregating occupations

Whereas the definition of occupations is the central concern of the dictionary-format DOT, for the SOC the central focus is the aggregation of occupations into larger clusters or job families, consistent with its design as a comprehensive top-down descriptive classification system. Any aggregation is based on principles of clustering using given variables (in our terminology, sorting variables). Different variables can be used to make distinctions at different levels of aggregation. For example, the initial broad division of occupations could be on the basis of skill level, followed by industrial sector. Within each of the broad categories produced by this aggregation, different variables might be appropriate to distinguish among occupations. For example, occupations at a low skill level might be distinguished by "degree of physical effort," while those at a higher skill level might be distinguished by "management skills required."

The current SOC has four levels of aggregation. The most aggregate level, the division, has 22 categories (not identified by code). Within each division there are 3 to 5 major groups, each identified by a 2-digit code. The major groups are subdivided into from 3 to 7 minor groups, identified by a 3-digit code. Minor groups contain a cluster of 1 to 20 unit groups identified by a 4-digit code. The unit groups each contain a number of DOT occupations.

The number of levels of aggregation, and the number of categories within each level, are fairly similar to the systems used in other countries. The *number of levels* of aggregation and the *number of categories* within each level of the SOC have not been widely criticized, suggesting that most users find little fault with the overall architecture of the nested hierarchies. Although it is possible that more extensive use of the SOC would generate suggestions for improvement, there is strong justification for retaining a basic architecture that is consistent over time and that is compatible with the major international systems, notably the ISCO-88 and the Canadian national taxonomy.

The *principles of aggregation* have, however, been challenged. In particular, much of the current debate on revising the SOC and DOT revolves around the usefulness of placing a measure of skill or substantive complexity at the center of occupational definition and classification. In other words, skill would become the prime "sorting variable" for occupations, at least to distinguish among the initial broad categories of jobs. The impetus for this derives from increased interest in issues of worker retraining to deal with economic dislocation, and moves to develop more relevant educational curricula. Several countries have implemented "skill-based" OCS, including Australia, Canada, the Netherlands and the United Kingdom (Wootton, 1993). The secondary and tertiary variables used in successive finer levels of aggregation are usually based on skill type and/or industry, similar to type of work performed.

Although measures of skill form part of the definition of an occupation in the SOC, it is only a secondary criterion for grouping DOT titles into unit groups. Hence, some of the SOC unit groups contain a mix of DOT titles with different skill levels, as measured by SVP or GED. In these cases, there is no way to determine a "typical" rating taking into account the different weightings of the DOT titles within the unit group, except to define the range encompassed by the various scores in the unit group.

Creating a database

Once the basic occupations are defined and organized into aggregations, they create the framework for insertion

of additional information organized by occupation (or cluster of occupations). These additional data elements (supplementary variables, in our terminology) are extra pieces of information in the dictionary entry for that occupation. For example, census data on gender mix within occupation, or projected local demand derived from labor market analysis, could be tied to occupational categories using crosswalks between the systems. These variables can then be used to create special aggregations and tabulations. For example, a user might select a subset of the fastest growing occupations in a locality, and aggregate them into broad clusters based on (for example) required education. The user could then describe the clusters in terms of working conditions, gender mix, and so on.

In the current system, there are two sources of information associated with occupations that are potentially part of a database. First, there are approximately 70 variables rated in the DOT, derived from data collected during job analysis. The reliability of these data depends on the extent to which the judgement about a "typical" establishment is in fact representative of the range of establishments. There is no equivalent information for the SOC basic units, although on inspection it may be possible to assign scores for given variables to particular SOC occupations if the ratings for the various component DOT titles are not too heterogeneous. A second source of information for a potential database consists of surveys conducted by other agencies using the DOT and SOC categories, or categories that can be related to them. The U.S. Census of Population and the Occupational Employment Statistics (OES) findings include estimates of the number of people employed in each occupation (corresponding to SOC categories) by geographic area, as well as demographic and industrial characteristics. Other Federal Government agencies that may collect data with an occupational variable include the Immigration and Nationalization Service, the Equal Employment Opportunity Commission, the Department of Health and Human Services (especially programs related to welfare recipients), the Social Security Administration, the National Labor Relations Board, the Occupational Safety and Health Administration, and various public employment services provided under the Department of Labor (such as unemployment insurance). At the state level, occupational information may be drawn from agencies dealing with rehabilitation, corrections, employment development, worker's compensation, occupational health, and the administration of welfare payments. Any survey sample from a private agency that uses an occupational classification that is comparable to one level of the DOT/SOC could also be used: this includes records from large employers, educational institutions, hospitals, and so on.

Individuals may construct their own databases by putting together DOT/SOC dictionary data with selected records from other sources. Local agencies may construct regional databases with local geographic data banks and finely detailed geographic data. (The incorporation of geographic information into the database is discussed in a later section.) The extent to which other sources of data are incorporated into a DOT/SOC master database depends on the resources available and the reliability of the data. An evaluation of the priorities of users, as well as of the real need and applicability of the data, should play a role in allocating resources to constructing the database.

Conclusions

A number of concrete questions to be addressed in the revision of the DOT/SOC system emerge from this analysis of classification issues. The issues may be related to the four conceptual elements of the design of a classification system: Selecting variables, defining occupations, aggregating occupations, and creating a database.

1. Perhaps the most fundamental choice is the selection of sorting variables for the DOT. The selection of these variables will in turn determine the possible choice of sorting variables for the SOC. Supplementary variables to be collected for inclusion in a database organized by DOT and SOC categories also need to be selected, but this is a process that can take place once the initial design of the system is established.
2. The question of the broad number of basic units in the DOT system ("titles") should be considered a policy decision, rather than the outcome of a natural process. It should be considered in relation to the appropriate number of SOC basic units, since the SOC occupational classification (the "unit group") will represent the first level of aggregation of DOT titles. The selection of the number of SOC occupations should be made with reference to the occupational categories currently used in the OES and the Census.

   The impact of existing DOT methodology (an industry-centered approach to defining occupations) on the number of occupations defined should be examined to avoid inconsistency in the specificity of occupational definitions.
3. The system architecture comprises the aggregation of occupations into larger clusters. General decisions need to be made about the optimal number of *levels* and the number of *categories* within each level. The principles of aggregation need to be identified in general terms, and made operational by referring to specific sorting variables.
4. The new information technology presents an opportunity for the creation of a readily accessible and comprehensive database. Decisions must be made on the level of aggregation at which informa-

tion is to be collected, the form in which it is to be presented (for example, embedded in identifier codes), and how it is to be updated and maintained.

Recommendations concerning four conceptual elements for a revised SOC are presented in the second half of this report. The next section lays some of the groundwork for these recommendations by discussing the priorities and information needs of users and potential users of occupational information.

Priorities and Needs of Potential Users

Objectives for gathering information from users and potential users of occupational classification information

Several authoritative surveys of DOT users have been carried out, including the critical review by the National Academy of Science (1980), responses to a concept paper published in the *Federal Register* (Silver, 1990) and more recently, a survey of over 1,700 users (Westat, 1993). These surveys provide the best overview of the current role of the existing DOT/SOC system and the range of user needs. However, several issues central to this report have received relatively little attention. It is worth noting that most surveys have been based on users of the existing system, and hence have tended to neglect those potential users who currently are unfamiliar with the system and find that it does not meet their needs. To probe beyond these boundaries of self-selected users, comments were elicited from voices which might not otherwise be heard. An informal effort of interviews and information gathering for this report focussed specifically on the relationship between the societal goals identified as important by individuals and the information they believe is needed in a revised system.

The goal of this effort was to garner comments and informed opinions about issues underlying the revision of the DOT/SOC system from both current users and potential users of a revised system. Consistent with our emphasis on the societal purposes of the occupational classification system, inquiries were made of individuals who assist workers through counseling, education, job placement, labor union organizing, and other worker-centered activities. Our secondary focus was on individuals with wide-ranging and inclusive understanding of the labor market and the role of occupational information, such as researchers and employees in state agencies. By focussing on these groups, and contacting knowledgeable informants, it was possible to obtain incisive and thoughtful comments about issues that are central to this report, but outside the scope of surveys that have been conducted. Views and insights were obtained from over 60 individuals through this informal, broad-ranging effort to explore the concerns of potential users and to identify interrelationships between individual's social priorities and the kinds of classification information they think are most important.

Problems with occupational classification systems

The most common problem in using occupational classification systems, cited by almost half the individuals contacted, was that the information was out of date. In the words of one respondent, "As a national push is made to create new industries and jobs based on technology development, totally new job classifications will emerge, and work must be done to integrate these impending job requirements with satisfactory information systems which can detail all the skills and abilities of current workers who may currently reside in a completely different industry."

The next most common complaint, cited by slightly more than a third of the individuals contacted, was that the system does not accurately describe jobs. Slightly less than a third of the individuals indicated that there are too many job definitions. Other significant concerns were that jobs were not grouped together appropriately, that the respondent was not trained to use the DOT, and that important information is missing. Some specific deficiencies were noted, for example, "The current DOT does not have enough categories for all kinds of social service and nonprofit jobs, but has too many agricultural and manufacturing jobs."

These responses can be understood as reflecting two levels of reaction to the existing occupational classification system. At the first (and most common) level, individuals encounter concrete difficulties when trying to locate or define an occupation, and experience frustration at the out-of-date information, inaccurate job definitions, and (occasionally) missing information. At the second level, individuals reflect on the limitations of the system and consider ways in which their frustration is related to system design; hence complaints about the number of job definitions and the grouping of jobs.

Societal objectives for the work force given the highest priority

A strong consensus emerged on the relative importance of some of the societal goals identified, while others evoked a greater diversity of responses. Informants largely agreed that it was important to identify essential skills and competencies, and to help displaced workers transfer skills. These two objectives of skill identification and skill transferability were affirmed by over three-quarters of the informants, while others evoked a greater diversity of responses. This finding is consistent with a survey of DOT users that found 58 percent considered skills transferability between occupations very important (Westat, 1993, p. 5–1)

Respondents also showed a strong desire for an occupational information system that provides reliable, current

labor market information, with two-thirds giving it a high priority. In the words of one, "We need access to trends in an easily decipherable form. What's growing? What's shrinking?"

This issue is closely related to interest in reliable projections of future employment, and so not surprisingly, this also received a high priority rating by over half the informants. Opinions were also gathered on other research uses for the system, including integrating social and occupational information, doing historical analysis, making comparisons with other countries, and investigating work-related health problems. However, these were not as popular as projecting employment, with over one-quarter of the respondents rating them as low priority.

Over half of the individuals contacted indicated that helping workers make successful job and career choices was only a medium priority, although relatively few indicated that it was unimportant. There was more disagreement about helping workers identify career advancement opportunities, with a strong divergence of opinion about the importance of this activity. A similar pattern of mixed responses was received with regard to the issue of helping people overcome barriers to employment.

Necessary information identified by users and potential users

An overwhelming consensus emerged regarding the priority of *skill requirements* as a central element in an occupational classification system, with nearly all informants indicating that this is of great importance. This was followed in magnitude by descriptions of tasks performed, which three-quarters of the informants indicated was of great importance. The third most significant item was information about which industries use specific occupations, which two-thirds of the informants indicated was important. This is consistent with the finding in the DOT user survey where 76 percent rated basic skills required as very important, and 79 percent regarded information on the duties and tasks performed as very important (Westat, 1993, p. 7–2).

Some specific suggestions were made about how to improve measurement of skill. One person called for GED scores with a "critical thinking" breakout, and Specific Vocational Preparation (SVP) scores with a breakout to include both formal education and training, plus on-the-job training and length of time. Others pointed to the need for information on actual certification requirements, as well as abstract summaries such as SVP. This would include licensing, registration, accreditation standard, and typical educational qualifications required, such as BA or BS. Findings from a survey of DOT users (Westat, 1993) indicate that a majority believe changes to the SVP code (to a measure of hours of preparation) and to the GED code (replacing it with the actual technical knowledge required) to be very or moderately important.

Drawing on a factor analysis of the fourth edition DOT produced by the 1980 critical review of the DOT (National Research Council, 1980), the subject areas of motor skills, physical demands, management skills, interpersonal skills, and working conditions were identified as distinct from each other and from the subject area of substantive complexity (included to some extent in the measure of skill discussed above). On the whole, most informants believed that motor skills (such as dexterity), physical requirements (such as lifting), management requirements (such as planning ability), and working conditions (such as heat) were of medium importance. These findings are echoed in part in the DOT user survey, which found that the rating of "very important" was assigned to physical requirements by 51 percent and to working conditions by 48 percent (Westat, 1993, p. 3–6, 3–7).

There was rather more diversity of opinion regarding the importance of information about interpersonal skills (such as tact), organizational context of jobs (such as firm size or level of unionization), and mobility potential (upward of "lattice" career movement). In these three cases, assessments of the importance of these types of information ranged from low to high, with no single assessment of importance being supported by a majority of informants. The DOT user survey (Westat, 1993) also found that information on career progression or paths was valued relatively low (with only 33 percent rating it as very important). Some informants argued that the changing economy called for a focus on more generic skills, including greater attention to the supervisory requirements, responsibility, and cognitive abilities of occupations. For example, one informant suggested, "More focus on the general personal attributes required in different occupations and industries, rather than on specific skills, e.g. responsibility, adaptability, motivation, cooperativeness. Focus on the attitude dimension rather than specific mechanical skills and requirements that are either obvious or readily acquired on the job."

Information about the organizational context of jobs received the least interest, with one-third of the respondents indicating that this was of little importance. One respondent did put forward a cogent defense of this information element, calling for, "Information that would help describe the organizational context of the work (supervisorial relationships, position of job in promotion ladders, firm size, structure, policies etc.) and demographic characteristics (including turnover)."

Among the items that respondents specifically mentioned as deserving more attention, most important were more information on wages and benefits, and closer links between labor market trends and occupational information.

Relationships between societal objectives and suggested improvements

The societal goals regarded as most important by individuals influence both selection of essential information for an occupational classification system, and prescriptions for correcting perceived shortcomings. Consequently, it is interesting to examine the needs and comments of groups of informants based on their ratings of societal goals.

There were five broad goals that were regarded as very important by more than half of all informants. Three of the goals were directly related to concrete problems of counseling and assisting work-seekers, namely identifying essential skills, helping displaced workers transfer skills, and helping people with barriers to employment find jobs. Consequently, there was substantial overlap among the individuals giving a high priority to these goals. These informants included a significant share of people engaged in job placement, counseling, training, hiring, setting wages, and organizing workers. Relatively few were engaged in research, and they tended to give rather little support for research-related issues.

The other two goals that attracted a great deal of support referred to research activities that provided indirect support for worker needs. The goals were providing up-to-date information about labor market changes, and assisting researchers to project future employment. The group of respondents concerned about current information seemed to straddle the employment and research orientations, focussing on a research output that would have direct utility for job placement. The respondents interested in predicting future employment were more sympathetic to the social benefits of all occupational research, such as historical analysis. Two-thirds of these respondents were engaged in research.

It is possible to identify some differences between the job-placement orientation on the one hand and the research orientation on the other (and sub-groupings within each), but more striking is the overall agreement among all respondents. For each of the five groupings defined above by their rating of high priority societal goals, the most common problem reported was out-of-date information, followed by inaccurate job descriptions and too many job definitions. The fourth problem cited was either inappropriately grouped jobs, or lack of training in DOT codes and traits data.

A similar agreement was evident in the judgement about the most important information that an occupational classification system should include. Only small variations were observed among groups. For example, placement-oriented informants tended to give more weight to the need for specific information on interpersonal skills, probably derived from experience with problems in placing work-seekers. Information on interpersonal skills may be especially relevant to service sector jobs drawing on "emotional labor," communication and social skills (especially jobs historically assigned to women) that have grown in recent decades.

Some variations between the placement orientation and the research orientation were also evident in the concrete suggestions made to improve the DOT/SOC system, although there was a fair amount of overlap among the five groups. Placement-oriented individuals suggested ways to link the occupational classification system more directly with real job and training opportunities. Suggestions were made to establish a database on local level demand with wage/benefit summary, training requirements, and occupational outlook. One specific proposition for a local database was to list the telephone numbers and main office addresses for community college districts, adult schools, and other job training sites for training in specific skills to be employer-acceptable. Another noted that we need to address confidentiality issues, and provide to the public employer names and addresses, and what occupations they use. In his words, "We must start providing more than 'symbolic' information."

The comments elicited from research-oriented individuals tended to call for greater links between different databases and sources of information. Suggestions were made for more use of the DOT by government agencies collecting labor market information, for consideration of the SCANS initiative, and for a standardized classification system. One recommendation spelled out a method for surveying under-represented sectors to generate a weighted distribution of industries, and produce a distribution of DOT titles within each OES code. The need for more localized demand and wage information was mentioned by several, as was the need to match occupational information with supply information from training programs.

Specific suggestions

The wealth of expertise on issues of employment and occupational information among the informants generated a number of insights worth mentioning in detail. Some pointed to new kinds of information that could be collected to shed light on current problems. For example, one individual called for information on the key characteristics of workers who retain employment for one year or more. Another noted that we need to link worker characteristics to firm characteristics. He suggested a random sample of workers at the workplace (as done in Japan) rather than at home (as done in the United States). The different variables appropriate for defining different occupations are outlined by one respondent, "To adequately reflect what the labor market is like, some information needs to be based on traditional occupational definitions, (that is, taxi drivers), some on industry associations, (opportunities in health care) and some on changes in technology (materials fabrication, toxic waste cleanup)."

Other individuals referred to the opportunities created by information-processing technology. "We need a com-

plete, comprehensive database and need to enable information users to be able to download what they need when they need it." . . . . "Due to the extensive number of occupations it is essential that the system be computerized. Our current system (OASIS) provides all the information required in seconds. This information is utilized to assess training needs, on the job training and regional employment job matches. It provides information for career development as well as career changes. It has a complete analysis of required education, training, etc."

Finally, the problems of designing a satisfactory occupational information system elicited some general comments. "No single system for classifying occupations will meet the needs of all users. Some look for very specific information, others look for generalized information. A hierarchical system allowing for different levels of detail may meet the needs of most users." . . . . "The three systems of OES, DOT and CIP each serve well in their appropriate applications. As long as all three can be integrated and crosswalked, all are useful. Our main concern is that the DOT is no longer getting updated frequently enough. We believe that there is a need for a more generalized system like OES or SOC as well as a more detailed system like the DOT. If one system could combine both features, all the better. It would seem that the Data, People, Things designation of the DOT could be incorporated with a hierarchical system like OES using a greater number of digits in the code." . . . . "Eliminate the SOC and the old DOT, improving on the OES so that there is only one taxonomy of about 2000 job titles. Then, don't alter the codes for ten years."

Conclusions

A wide net was cast to draw on the expertise and opinions of individuals in diverse positions with rather different approaches to the potential use of an occupational classification system. The dimensions of their different perspectives on the social goals to be served by the DOT/SOC system have been outlined above. However, it is interesting to note that despite some diversity in origin, they share a remarkably strong consensus on the necessary information that an occupational classification system should contain, and the major problems currently experienced by users. Consequently, the problem of balancing the conflicting demands of different user groups in the revision may not be as severe as expected. There appears to be fairly broad support for changes that transform the DOT/SOC in the direction recommended later in this report.

Using the SOC for Job-Worker Matching: A Case Study of Machine Trades Occupations in the Aircraft and Aerospace Industries

Introduction

An expected use of job groupings in the SOC or DOT is to identify "lattice" opportunities for enabling workers to find new jobs that use their existing skills. The first edition of the DOT was developed to "facilitate the proper classification and placement of work seekers," a goal carried through the Fourth Edition, which acknowledges the "continued primacy of job-worker matching as the reason for its existence" (National Research Council, 1980: 196–197). Traditionally, workers have been matched to job openings on the basis of the detailed DOT titles. This narrowly-based matching may work if jobs are available in workers' occupations, but is too restrictive if one considers the universe of possible jobs into which workers could, or may need to, transfer their skills.

Information about jobs and occupations that match workers' qualifications and interests is especially important for workers entering or re-entering the labor market, changing occupations and industries or both, or changing places of residence. The SOC, through links to unit groups of detailed DOT titles, can be used to find families of occupations that are relatively homogeneous along one or more user-selected variables, such as worker functions, General Educational Development (GED), and Specific Vocational Preparation (SVP). However, such broadly-based matching raises problems of its own: on what basis is it determined that occupations are similar enough to facilitate skills transfer across occupations, that is, outside of occupational job ladders? How useful is the skills-based information used to compare occupations? Is there a way to prioritize possible job matches, for example, by taking into account local labor market information on employment, wages, turnover, and other relevant data?

This problem will be examined through a case study of Machine Trades occupations in the Aircraft and Aerospace industry. The decline in Federal defense spending has forced defense contractors, many of them based in Southern California, to eliminate tens of thousands of jobs. Between 1988 and 1992, over 95,000 jobs were lost in Los Angeles County's heavily defense-dependent aerospace and electronics industries (Economic Roundtable, 1992). Many aircraft and aerospace workers, like those in other restructuring industries, have lost their place in what were once stable job ladders that gave many workers all the information they needed to know

about the labor market. Jobs related to their skills and interests are declining in their industry, and often in related industries, forcing many workers to make a career change, which may involve a "downward" move in the labor market into a job outside of their specialization. Workers set adrift in the economy are in great need of information regarding occupations and jobs that match their education, training, experience, and job expectations.

To explore lattice opportunities for reemploying aircraft machine trades workers, the DOT files were copied into dBase, sorted, and imported into Lotus123. Once the records are in dBase or a similar database management program, the user can easily sort the more than 12,000 DOT occupations on the basis of one or more sorting criteria. The sorted files can be manipulated in spreadsheet programs such as Lotus123 and QPRO. This capability makes the DOT database extremely flexible to user requirements for sorting and grouping occupations. To help prioritize occupations in which workers might find jobs, detailed data on employment by industry and OES group in Los Angeles County was used. This data set was compiled by the California Employment Development Department.

Are the families of DOT occupations grouped together in the SOC as it is currently structured useful to aircraft and aerospace workers seeking a job outside of their immediate specialization? What information provided by the DOT and SOC is most valuable for facilitating job matches? What information not currently included in the DOT and SOC would be helpful to workers? These questions are addressed first by describing machine trades occupations that the DOT identifies as used primarily in the aircraft industry. Second, a narrowly defined search is conducted in an effort to identify potential reemployment opportunities in occupations that have related classifications in the DOT and SOC systems. And third, under the assumption that one of the most important bridges between occupations is skills transferability, DOT variables for worker functions and skill level are used in a broadly defined search for clusters of occupations in which workers in the aircraft and aerospace industries might find jobs suitable to their expertise.

Description of aircraft and aerospace machine trades occupations

Twenty-three Machine Trades occupations are classified by the DOT in the Aircraft and Aerospace industries. These occupations are a part of 15 SOC groups and 17 OES groups (tables 2 and 3). The occupations are described below with respect to worker functions, GED, and SVP. The GED scores are presented as an average of the GEDR (reasoning), GEDM (mathematics), and GEDL (language) scores. Two groups of occupations are distinguished: 14 Setting Up and Precision Working occupations, with above average skill levels and educational and training requirements, and 9 Machine Operating-Controlling occupations, with below average skill levels and educational and training requirements. The skill level of an occupation is indicated by the Things function, GED, and SVP codes, which are structured hierarchically on the basis of skills, work complexity, and responsibility.

Setting Up and Precision Working Occupations. The DOT occupations in this group are identified by a Things function of 0 (Setting Up) and 1 (Precision Working). These occupations require considerable judgment in the execution of work tasks (U.S. Department of Labor, 1991: 3–2). The average GED for Precision Working and Setting Up occupations was between 3.3 and 4.3; 10 of the occupations have an average GED of 4.0 or 4.3. Most of the occupations require 2 to 4 years of vocational training and job experience, based on an SVP of 7.

Eleven of the 14 occupations are classified into 2 DOT Occupation Groups, Aircraft Mechanics and Repairers (621) and Model Makers, Patternmakers, and Related Occupations (693). DOT occupations include Airframe-and-Power-Plant Mechanic (621.281–014), who "services, repairs, and overhauls aircraft and aircraft engines;" Model Maker (693.261–018), who "lays out, assembles, fabricates and assembles scale models of aeronautical and aerospace products;" and Tool Builder (693.281–030), who "lays out, fabricates, assembles, and repairs jigs, fixtures, forms, templates, and related tooling used in manufacturing aircraft parts and assemblies."[4]

Machine operating-controlling occupations. Operating-Controlling occupations are identified by a Things function of 2. These occupations require less latitude for judgment than do Setting Up and Precision Working occupations. The average GED for occupations in this group is below average, between 2.3 and 3.0. Seven of the nine occupations have an SVP of 4 or 5, requiring 3 months to 1 year of vocational education and training. Machine Operating-Controlling occupations in the Aircraft industry are classified into 6 DOT groups. Three are Metal Machining groups, including Milling, Shaping, and Planing (605), Boring (606), and Sawing (607). Less complex cognitive skills are required for these occupations, compared with the Precision Working and Setting Up occupations. Workers are typically following instructions and machining metal parts to be assembled into aircraft, missiles, and related products.

DOT occupations include Numerical-Control Router Operator (605.382–046), who "sets up and operates numerical control router machine to rout (cut) parts, such as . . . metal workpieces from metal stock;" Hammer Operator (617.382–014), who "operates reciprocating power hammer to smooth and shape sheet metal used to manufacture aircraft and aerospace products;" and Fluid Jet Cutter Operator (699.382–010), who "sets up and operates high-speed water jet cutter to cut and trim parts from assorted materials."

Setting Up and Precision Working occupations are more highly skilled than the Operating-Controlling occupations in terms of latitude for judgment, GED, and SVP, each of these occupations requires specialized knowledge. While workers in the former group may need to understand principles of aeronautical engineering, or be able to solve problems in repairing aircraft engines, the workers in the latter group develop skills in working with specific machines, such as routers, cutters, and hammers.

Occupational matches using narrowly-defined searches

The narrowest job search using the SOC is confined to one DOT title. For example, an aircraft mechanic may be classified as an Airframe-and-Power-Plant Mechanic (DOT 621.281–014). Any job requests matching the occupation title are referred to the worker. In the case of a declining or restructuring industry, this search is likely to prove fruitless. Workers in this case need information regarding skills transferability between occupations.

The SOC/DOT is a flexible system, in which occupations can be matched on the basis of user-defined criteria. Narrowly-defined searches include:

- Matches based on the first six digits of the DOT
- Matches based on SOC or OES groups

Broadly-defined matches can be created, based on various combinations of the first six DOT digits, and/or GED, SVP, and other variables attached to each occupation title. The use of computers makes any of these searches a relatively simple exercise; the main questions pertain to the basis of the search, and the quality of the matches.

Matches using the first six digits of the DOT title. Occupations that share the first six digits of the DOT title are deemed to be similar with respect to job-specific knowledge (the first three digits) and worker functions or traits (the middle three digits). For example, the Airframe-and-Power Plant Mechanic shares the first six digits of the DOT title with two other occupations: Airframe-and-Power Plant Mechanic Apprentice (621.281–018) and Rocket-Engine-Component Mechanic (621.281–030). Based on the information contained in the DOT title, workers in these occupations can be described as aircraft mechanics and repairers whose jobs involve data analysis, taking instructions, and precision working. The search can be expanded somewhat by taking all occupations sharing the first three digits of the DOT title. These searches are highly restrictive, especially in the case of industry-specific occupations like Aircraft Mechanics and Repairers. This search strategy is not helpful to laid-off aerospace workers because the potential new jobs it identifies are all within the same industry group, and are all experiencing the same decline in demand for workers.

Matches using SOC and OES groups. SOC and OES groups provide another basis for grouping DOT occupations. The Machine Trades occupations are distributed among 15 SOC groups. Some of the SOC groups are relatively homogeneous with respect to worker functions and skills variables. The Machinists group (SOC 6813) is comprised of 11 DOT titles, which have an average GED between 3.3 and 4.0, and a range in SVP from 5 to 8 (nonetheless, most of the DOT occupations had an SVP = 7). However, a weakness of the SOC is that some groups contain over 100 DOT titles, which can be very diverse in terms of worker skills and other criteria. For example, the Precision Patternmakers, Lay-Out Workers, and Cutters group (SOC 6862) includes 28 DOT occupations, with average GED between 2.0 to 4.0, and SVP between 2 to 7.

Potential mobility between occupations was evaluated with respect to other DOT occupations in their OES group. The OES group was used instead of the SOC group in order to apply local labor market information, which is invaluable in prioritizing matches between occupations. (For all intents and purposes, the OES contains the same unit groups of DOT titles as the SOC, with several minor variations due to updates since 1980). In this example, the EDD data on employment by OES group and industry was used, to indicate occupation-industry paths employing the most workers, and showing the best prospects for employment growth.

The Aircraft Machine Trades OES groups are shown in table 4, which includes employment by industry in Los Angeles in 1988 and 1991. The OES groups in which significant numbers of workers were employed in 1991 included:

(OES 85323)	Aircraft Mechanics, 4,930 workers
(OES 89108)	Machinists, 3,540 workers
(OES 91502)	N/C Machine Tool Operators and Tenders, 1,620 workers
(OES 83002)	Precision Inspectors, Testers, and Graders, 4,800 workers

Possible job transfers within each group are evaluated below by considering the skills homogeneity of the DOT titles in each group, and the demand for workers in the industries that utilize these occupations (see tables 5 and 6).

Aircraft mechanics (OES 85323)

Eight DOT occupations make up the OES classification for aircraft mechanics, including five occupations that are linked to the Aircraft industry. The SVP's for these occupations range from 3 to 7, with an average of 5.6. The higher-skill group includes four occupations—Airframe-and-Power-Plant-Mechanic Apprentice (Air Transportation), Aircraft Body Repairer (Air Transportation), Experimental Aircraft Mechanic (Aircraft), and Airframe-and-Power-Plant Mechanic (Aircraft and Air Transpor-

tation)—that require 2 to 4 years of training (SVP 7), have average GED scores between 3.3 and 4.0, and involve data analysis and precision working.

There were 4,930 Aircraft Mechanics in the Aircraft and Aerospace industry in Los Angeles County in 1991, which was almost three-quarters of the occupation group's 7,760 employees in all county industries. Most of the other Aircraft Mechanics (29 percent) were employed in the Air Transportation industry. Employment of Aircraft and Aerospace mechanics declined 11 percent between 1988 and 1991, while it increased 9 percent in the Air Transportation industry and by 12 percent in Airports, Flying Fields and Services. Employment in the occupation group fell by 4 percent, from 8,110 to 7,760. Although 240 Aircraft Mechanic jobs were added in Air Transportation and Airports, Flying Fields and Services, 580 jobs were lost in the Aircraft and Aerospace industries.

Machinists (OES 89108)

This OES group includes 11 DOT occupations in 7 industries. One occupation is unique to the aircraft industry (Rocket-Motor Mechanic). The DOT occupations have SVP's of 7 or 8, with an average of 7.3. These are highly skilled jobs, with training requirements between 2 and 10 years. Each of the occupations is a skilled setting-up or precision working occupation. Average GED values are between 3.3 and 4.0.

The main distinction among the Machinist occupations is the industry in which they are classified. The Aircraft and Aerospace industry employed 3,200 (17 percent) of Los Angeles County's Machinists in 1991. Most Machinists (4,880, 26 percent) were employed in machine shops classified in SIC 359, Industrial Machinery NEC. Smaller concentrations of Machinists were in the Metalworking Machinery Industry (SIC 354, 970 workers), and the Screw Machine Products, Bolts, Etc. Industry (SIC 345, 880 workers). Overall, Machinists' employment declined 10 percent in Los Angeles between 1988 and 1991, including a 13-percent drop in the Aircraft and Aerospace industries.

Numerically-controlled machine tool operators and tenders (OES 91502)

This group comprises 12 DOT occupations in 3 industries, including Aircraft, Machine Shops, and Electronic Components. Four occupations are linked to the aircraft industry: Shot-Peening Operator, Robotic Machine Operator, Automated Cutting Machine Operator, and Numerical-Control Router Operator. Seven of the remaining eight occupations are machine shop occupations. The SVP values range from 4 to 7, with an average of 5.4. Job titles include Robotic Machine Operator (Aircraft and Aerospace), Automated Cutting Machine Operator (Aircraft and Aerospace), and Numerical Control Lathe Operator.

Los Angeles County's 3,640 N/C Machine Tool Operators and Tenders were concentrated in the Aircraft and Aerospace industry (1,510 workers, 41 percent of the group total) and the Industrial Machinery NEC industry (900 workers, 25 percent of the group total). The occupation group's employment fell by 14 percent between 1988 and 1991, including a 13-percent drop in Aircraft and Aerospace.

Precision inspectors, testers, and graders (OES 83002)

This is a large OES group, including 111 DOT titles, of which 14 are unique to the Aircraft industry. Precision Inspectors, Testers, and Graders are attached to 44 industries by the DOT. SVP values run the gamut from 2 to 8, with an average of 6.5. Most of the occupations have an SVP of 6 or 7, and average GED values between 3 and 4. Almost all of the occupations (102 of 111) are classified as precision working occupations.

In Los Angeles County, Precision Inspectors, Testers, and Graders are most strongly represented in the Aircraft and Aerospace industries, which employed 3,220 (30 percent) of the county's 10,830 workers in this group. The next highest concentration was in the Instruments industry (2,160, or 20 percent). The Electronic Components industry (SIC 367) employed 811 (8 percent) workers in this group, followed by Telephone Communications (550 workers, 5 percent of the group total). The eight occupations grouped with the Instruments and Telephone Communications are Precision Working occupations, with values for GED and SVP similar to those of the aircraft occupations. The three occupations tied to the Electronic Components industry require less educational background than the aircraft occupations; one is a very low-skill occupation (Leak Tester, Semiconductor Packages).

Employment in the OES group declined by 16 percent between 1988 and 1991 in Los Angeles, from 12,940 to 10,830 workers. Employment declined by 13 percent in the Aircraft and Aerospace industry between 1988 and 1991, and by 19 percent in the Instruments industries. The only industry showing a significant growth in the occupation group was SIC 384, Medical Instruments. However, the 110 Precision Inspecting, Testing, and Grading jobs created in this industry pale by comparison with the 2,110 jobs that were lost across all industrial sectors. The total employment decline in the occupation group was 19 percent.

Summary of findings. Within each of these occupation groups, jobs are declining in Los Angeles County. Taken together, employment in the four groups in the Aircraft and Aerospace industries fell from 14,600 to 12,900 between 1988 and 1991, a 12-percent attrition. With few exceptions, the employment picture for the four groups is as bleak outside of the Aircraft and Aerospace industries, dropping from 31,800 to 28,500, a 10-percent decline. Altogether, 5,080 jobs were eliminated in Los An-

geles County in the four OES groups, representing an 11-percent decline from 46,400 to 41,320. These trends have continued since 1991, with layoffs announced regularly by major aircraft and aerospace contractors. In all likelihood, aircraft and aerospace machine workers are forced to look beyond their occupation, and industry, for a job. The outcome of this search for potential absorption occupations is similar to the previously discussed search based on DOT codes; it failed to identify occupations outside of the declining aerospace industry that could use the skills of laid-off machine trades workers from the aerospace industry.

Occupational matches using broadly-defined searches

Matches among machine trades occupations. To broaden the search for occupations affording skills transferability for aircraft and aerospace machine workers, a set of all DOT titles in the Machine Trades Occupations (Occupational Category 6) with an SVP of 6 or more was created. This restriction was included under the assumption that aircraft and aerospace workers are interested in finding a job that uses their skills and experience and pays comparable wages (which are strongly correlated with SVP); thus jobs requiring less than average training time, experience, and education were excluded from the search.

This search resulted in a set of 633 DOT titles in 90 OES groups. Forty-six of the OES groups each employed at least 1,000 workers in Los Angeles County in 1991 (table 7). Only five of the OES groups showed an employment increase between 1988 and 1991. However, these groups include relatively few workers, and their employment increase makes a minimal dent in the job loss trend of higher-skill Machine Trades occupations as a whole. Overall employment in the 46 OES groups employing at least 1000 workers fell from 360,000 to 313,860 between 1988 and 1991, a 13-percent decrease.

Matches based on other user-selected criteria. Given the limitations in the potential movement of Los Angeles aircraft and aerospace machine workers into other machine working occupations, linkages between machine working occupations and all other occupations were sought. One possibility is to match occupations on the basis of their Worker Function Profile, the middle three digits of the DOT title. This creates a group of DOT titles across numerous industry groups and skill levels.

For example, the Worker Function Profile "261" is common to six Machine Trades DOT titles in the aircraft industry, including Engine Tester, Rocket-Motor Mechanic, and Model Maker. Altogether, there are 235 DOT titles with the same Worker Function Profile. Workers in these occupations are engaged in analyzing data, speaking-signalling, and precision working. Over half of the occupations have an SVP of 7, and the largest concentrations of titles by industry group are in the Professional, High Technology, and Any Industry groups. Other important clusters of DOT titles were in the Utilities and Transportation group, and the Heavy Manufacturing industries. As is discussed in greater detail below, this search did not produce a list that distinguished good matches from poor matches.

Other searches can be conducted by selecting different combinations of variables and scores. The Machinists group (OES 89108) was selected as the basis for a computer search to identify potential absorption occupations, as the DOT occupations it contains are relatively homogeneous with respect to skill level variables. The purpose of this computer search was to find a cluster of occupations between which machinists might be expected to transfer their skills and find a job, on the basis of similar educational and training requirements, and worker functions.

The search was based on the following criteria:

Data Function -	2 (Analyzing)
Things Function -	0 (Setting Up) or 1 (Precision Working)
GEDR -	4
GEDM -	3 or 4
GEDL -	3 or 4
SVP -	7 or 8
APTITUDM (manual dexterity) -	2 or 3
MPSMS -	510, 530-610

This computer search identifies a group of 285 DOT occupations attached to 55 industries and 79 OES groups (table 8). Five industries contain 106 of these occupations: Machine Shops (40 titles, including 4 Machinists), Aircraft (20 titles, including 1 Machinist), Utilities (16 titles), Automotive Services (11 titles, including 2 Machinists), and Ship and Boat Manufacturing (10 titles). The OES groups containing the most titles include OES 83002, Precision Inspectors, Testers, and Graders (37 titles); OES 85119, All Other Machinery Maintenance Mechanics (18 titles); and OES 89102, Tool and Die Makers (13 titles). As with the previous search, this search did not provide a useful, prioritized list of potential job matches.

Table 9 shows 40 DOT occupations in the Machine Shop industry, including four machinist occupations, and 36 occupations with skill levels and worker functions similar to those of Machinists. If the aerospace sector were growing, this group might hold good possibilities for some aircraft and aerospace machinists, as it includes occupations with relatively high skill levels in an industry closely tied to aircraft and aerospace manufacturing. A sample of DOT titles includes:

DOT Code	DOT Title
601280–022	Die sinker
601281–018	Inspector, gauge, and instrument
603280–018	Grinder operator, tool
604280–0[illegible]	Turret-lathe set-up operator, tool
606280–010	Boring machine set-up operator, jig

Outside of the Machine Shop industry, employment in the OES groups associated with Machine Shop DOT titles fell between 1988 and 1991 in Los Angeles. For example, 11 Machine Shop DOT titles are classified in OES group 89102, Tool and Die Makers, which experienced a 17-percent decline in employment between 1988 and 1991, from 4,740 to 3,920 workers, while the employment of Tool and Die Makers in Machine Shops increased from 351 to 440 workers during the same time period. The value of using industry-occupation employment data is to show that, while job prospects in Los Angeles are not good in most machine trades occupation groups, there are avenues that workers could pursue in an initial search of jobs in their occupation. The problem remains, though, that there is a surplus of Tool and Die Makers and other machine trades workers applying for jobs in the local labor market.

Summary of findings. These broadly-based searches produced long lists of occupations that shared similar characteristics based on worker functions, GED, SVP, and related variables. These matches were intended to create groups of occupations on the basis of potential skills transferability. However, there is no way to distinguish between high-quality matches and poor matches solely on the basis of generic variables such as GED and SVP. The DOT is structured for making highly specific matches between workers and jobs with the same, or closely related, DOT titles. Attempts to conduct broader searches on the basis of skills-related variables cast such a wide net, however, that their value is limited. What is needed for this purpose is specific skills information that captures the substantive complexity of jobs, and can be used to connect occupations that use similar skills.

The SOC and problems of job search in a restructuring economy

The SOC in combination with the DOT is a detailed, information-rich, flexible system for worker-job matching. Workers can be matched with jobs on the basis of narrow DOT titles or SOC groups. If a broader search is desired, the DOT titles are structured in such a way that searches can be conducted rapidly for any criteria based on the information included in the DOT title, as well as information attached to each DOT title. The end result is a highly detailed listing of DOT occupations that share similar scores along one, or several, variables.

The major problem with these searches is that they are not well-targeted. The narrowly-defined searches often conducted by Employment Service offices are highly restrictive, as they assume that jobs are available in a worker's DOT occupation, and the worker is unable to transfer into other occupations. Occupational matches within an SOC group are also unlikely to be fruitful for many workers, since most SOC groups are industry-specific, and many contain DOT titles that are heterogeneous in terms of skill levels (in which case vertical job ladders may be represented). These searches may be useful in the case of job search in a growing industry, with relatively stable job structures. This describes many manufacturing industries during the postwar boom, not the reality of job structures and industry development paths today.

The problem facing many workers today, especially in declining or restructuring industries such as aerospace, is the need to make a horizontal move in the labor market outside of their current occupation and industry that does not result in extreme downward mobility. The DOT is not well-structured for making occupational matches across industries on the basis of skills transferability. Broadly-based searches using GED, SVP, and Worker Functions variables as indicators of occupational skill levels result in a laundry-list of occupations. The GED and SVP variables are generic, time-related indicators of skill level that are not meant to capture specific skills requirements in different occupations. These searches are thus unable to distinguish the best-quality matches on the basis of wages, employment potential, and specific information regarding skills transferability. A near-term opportunity for providing wage information about occupations is available through the OES survey program. By collecting wage information in all states, rather than a limited subgroup of states, it would be possible to provide information showing both occupational and geographical comparisons of wages.

Although the DOT classifies occupations on the basis of tasks rather than skills, data on Worker Functions, GED, and SVP are hierarchically-organized with respect to skill, which is implicitly defined as task complexity. Using task complexity to define skill is problematic. As Attewell (1989) argues, why is fabricating a metal product from a blueprint deemed to be less complex (and therefore less-skilled) than giving instructions or scheduling tasks? Is a skills hierarchy reflected here, or simply a biased ordering of skills (and thus occupations) which prioritizes managerial over production work on the basis of authority relations, social status, and labor market outcomes, rather than the inherent skills of occupations? Such an approach appears to take for granted a dualism between cognitive and manual work, in which workers' knowledge has been appropriated by management, whose orders are executed by workers with little thinking. Although the DOT was not intended to create a hierarchy of occupations, its most important variables are based

on hierarchies of skills, and used to create hierarchies of occupations.

To what extent are skills objective phenomena that can be measured quantitatively? To what extent are skills socially-constructed or internalized? The ways in which these questions are answered will affect the design of the new SOC. At the very least, skills should be defined, competing definitions acknowledged, and the relationship between the conception of skill and the classification of occupations spelled out. In particular, any hierarchical ordering of skills, and hence occupations, should be made explicit. This does not mean that skills and occupations need to be ranked. Rather, the complexity of skills could be captured by evaluating the cognitive and physical demands of work, the authority and autonomy of workers, and the relations between workers and technology, to name some important dimensions of skill, without ranking skills or assuming that skills have to be measured quantitatively. Care should be given to evaluating underappreciated general skills, without assuming that jobs emphasizing general skills are inherently "less skilled" than jobs emphasizing specialized skills. The cognitive skills involved in all work should be understood, to evaluate internalized skills which develop through on-the-job experience. All of this requires conceptions of skill, and ways of evaluating skill, that go beyond the assumptions about skill embedded in the DOT, that prioritizes quantifiable measures of task complexity, educational requirements, and training time in its implicit determination of occupational skills.

What skills are transferable between occupations and industries? What skills are highly-specific to organizations and industries? The SOC should contain, and be linked with, information that helps workers answer these questions for a local labor market, and for the economy as a whole. For example, the highly specialized nature of most manufacturing jobs makes it difficult for workers to transfer certain skills outside of the organization or industry in which they are employed. In the aircraft and aerospace industries, workers use highly sophisticated machines to fabricate metals, plastics, and composites for assembly. Their skills, if not necessarily firm-specific, tend to be industry-specific. Unemployed aircraft and aerospace workers would first look for a job in another company in the same industry, or a closely related industry, such as air transportation, instruments, or machine shops. If this search turns up empty, workers need specific information regarding skills requirements and hiring criteria in different occupations, in order to evaluate the possibilities of moving into occupations that use their skills, and provide salaries and benefits that meet workers' expectations.

For example, are there jobs in different occupations that use skills already possessed by workers, such as computer-related skills, and various cognitive skills, that are not organization- or industry-specific? To find worker-job matches on this basis, occupations need to be evaluated and described using a common language of specific skills, rather than generic variables of training time and years of education. Occupational information should distinguish between highly specific and transferable skills, to clarify the connections that workers can make between occupations. To accomplish this, occupations should be classified primarily on the basis of skills, rather than tasks.

Occupational information should also help workers seek appropriate training for a desirable occupation. Do workers have to learn entirely new skills to compete for other jobs? What are the training and educational requirements? While the occupational classification system could only provide typical hiring criteria information for an occupation, this could be valuable in steering a worker towards retraining programs and vocational courses. Together with information on employment and wages, workers could prioritize occupations in a local labor market that hold out the most promise of employment, provided that they undergo appropriate retraining. A worker may decide that it is worthwhile to invest time and money in retraining, to learn a specific skill or set of skills, if the employment outlook for an occupation is positive.

Local labor market information on wages, employment, turnover, and specific job characteristics is essential to workers making decisions about job applications and training programs. To be effective, labor market information and occupational information should be collected for the same occupational classifications. One of the problems presented above is that employment and other labor market information is normally collected for OES or SOC occupation groups, rather than DOT groups. Given their high level of disaggregation, it is not feasible to collect labor market information for DOT groups. The drawback of this is that the occupational information contained in the DOT classification cannot be related directly to labor market information collected by OES or SOC group.

The SOC is useful to workers only insofar as it is reliable and up-to-date. This creates important demands to restructure the system to be constructed in such a way that revisions can feasibly be made in a timely manner. Job and occupational information should be readily accessible to workers. An unemployed aircraft or aerospace machinist should be able to go to his or her union hall, or a local library, or a job placement center and have access to information on job openings and hiring criteria on a computer database. The outcome of this process should be a personalized map of the labor market that arms the worker with information needed to decide his or her next move in increasingly difficult terrain.

Table 2. Machine trades occupations in the aircraft industry, Grouped by OES code

OES Code DOT Code	OES Title DOT Title	Average	
		GED	SVP
31314	Teachers and instructors, voc ed.		
621221010	Field-service representative	4.3	7
83002	Precision inspectors, testers, and graders.		
621261014	Engine tester	4.0	7
85323	Aircraft mechanics.		
621261022	Experimental aircraft mechanic	3.7	7
85326	Aircraft engine specialists.		
621281014	Airframe-and-power-plant mechanic	4.0	7
85928	Mech control and valve inst and rep		
621281030	Rocket-engine-component mechanic	4.0	7
89108	Machinists.		
693261022	Rocket-motor mechanic	4.0	7
89114	Pattern and model makers, metal.		
693261014	Development mechanic	4.0	7
693361014	Mock-up builder	4.0	7
89908	Precision pattern and model makers.		
693281030	Tool builder	4.0	7
693261018	Model maker	4.0	7
693261010	Developer prover, interior assemblies.	4.0	6
91102	Sawing mach tool setters and operators, metal.		
607382014	Saw operator	2.3	4
91111	Milling and planing mach setters and ops, metal.		
605382034	Router operator	3.0	6
91317	Forging machine setters and ops, metal.		
610362010	Drop hammer operator	3.0	6
91321	Forming machine ops and tenders, metal.		
617382014	Hammer operator	2.3	5
91502	NC machine tool ops and tenders, metal.		
617280010	Shot-peening operator	3.7	6
699362010	Automated cutting machine operator	2.7	4
606382026	Robotic machine operator	2.7	5
605382046	Numerical-control router operator	2.3	4
91505	Comb mach tool setters and ops, metal.		
616380018	Machine operator I	3.0	6
92197	All other metal and plastic mach operators.		
619380010	High-energy-forming equipment operator	3.3	6
92941	Cutting and slicing mach setters and ops.		
699382010	Fluid jet cutter operator	2.7	5
98102	Helpers, mechanics and repairers.		
621684010	Airframe-and-power-plant-mechanic helper.	2.3	4

Table 3. Machine trades occupations in the aircraft industry, Grouped by SOC code

SOC Code DOT Code	SOC Title DOT Title	Average	
		GED	SVP
2390	Adult ed and other teachers, NEC.		
621221010	Field-service representative	4.3	7
6116	Aircraft mechanics (except engine specialists).		
621281014	Airframe-and-power-plant mechanic	4.0	7
621261022	Experimental aircraft mechanic	3.7	7
6175	Mechanical controls and valve repairers.		
621281030	Rocket-engine-component mechanic	4.0	7
6813	Machinists.		
693261022	Rocket-motor mechanic	4.0	7
6817	Patternmakers and model makers (metal).		
693361014	Mock-up builder	4.0	7
693261014	Development mechanic	4.0	7
6862	Precision patternmakers, cutters.		
693261018	Model maker	4.0	7
693261010	Developer prover, interior assemblies.	4.0	6
693281030	Tool builder	4.0	7
6881	Precision inspectors, testers, and graders.		
621261014	Engine tester	4.0	7
7313	Milling and planing machine setup operators.		
605382034	Router operator	3.0	6
7319	Forging machine setup operators.		
610362010	Drop hammer operator	3.0	6
7326	Numerical control machine setup operators.		
605382046	Numerical-control router operator	2.3	4
699362010	Automated cutting machine operator	2.7	4
606382026	Robotic machine operator	2.7	5
617280010	Shot-peening operator	3.7	6
7329	Misc metal and plastic working set-up ops.		
607382014	Saw operator	2.3	4
616380018	Machine operator	3.0	6
7339	Misc fabricating machine set-up operators.		
619380010	High-energy-forming equipment operator.	3.3	6
7529	Misc metal and plastic working ops.		
617382014	Hammer operator	2.3	5
7678	Slicing and cutting machine operators.		
699382010	Fluid jet cutter operator	2.7	5
8632	Helpers, vehicle and mobile eq mechanics.		
621684010	Airframe-and-power-plant-mechanic helper.	2.3	4

Table 4. Machine trades OES groups
[Employment in the Aircraft and Aerospace Industries Los Angeles County, 1988 and 1991]

OES Code DOT Code	OES Title DOT Title	1988 Employment	1991 Employment	Percent change 1988-91
31314	Teachers and instructors, voc ed and training	6,969	7,146	3
621221010	Field-service representative			
83002	Precision inspectors, testers, and graders	5,776	4,795	−17
621261014	Engine tester			
85323	Aircraft mechanics	5,505	4,926	−11
621261022	Experimental aircraft mechanic			
85326	Aircraft engine specialists	519	456	−12
621281014	Airframe-and-power-plant mechanic			
85928	Mechanical control and valve installers and repairers	317	315	−1
621281030	Rocket-engine-component mechanic			
89108	Machinists	4,106	3,537	−14
693261022	Rocket-motor mechanic			
91102	Sawing machine tool setters and operators	191	173	−9
607382014	Saw operator			
91111	Milling and planing machine operators	564	496	−12
605382034	Router operator			
91317	Forging machine setters and operators	39	35	−10
610362010	Drop hammer operator			
91321	Forming machine operators and tenders	462	412	−11
617382014	Hammer operator			
91502	Machine tool operators and tenders, metal	1,880	1,624	−14
605382046	Numerical-control router operator			
606382026	Robotic machine operator			
617280010	Shot-peening operator			
699362010	Automated cutting machine operator			
91505	Comb machine tool setters and operators	282	248	−12
616380018	Machine operator I			
92197	All other metal and plastic machine operators	700	609	−13
619380010	High-energy-forming equipment operator			
98102	Helpers, mechanics and repairers	153	135	−12
621684010	Airframe-and-power-plant-mechanic helper			
	Total employment	27,463	24,907	−9

Table 5. Major OES groups employing aircraft and aerospace machine trades workers in Los Angeles County

DOT Code	DOT Title	Industry	Average	
			GED	SVP
	Precision inspectors, testers, and graders (OES 83002). DOT titles attached to the aircraft, electronic, machine shop and telephone communication industries grouped by SVP.			
806261050	Operational test mechanic	(aircraft mfg.)	3.3	8
601261010	Inspector, set-up and lay-out	(machine shop)	4.0	8
806261022	Tester, rocket motor	(aircraft mfg.)	4.0	8
822261014	Equipment inspector	(tel. & tel.)	3.7	8
822261018	Maintenance inspector	(tel. & tel.)	3.3	8
601281022	Inspector, tool	(machine shop)	4.0	8
726362010	Group leader, semiconductor testing	(electron. comp.)	2.3	7
621261014	Engine tester	(aircraft mfg.; air trans.)	4.0	7
601281018	Inspector, gauge and instrument	(machine shop)	3.7	7
869261014	Mechanical-test technician	(inst. & app.)	3.3	7
729361010	Inspector, electromechanical	(inst. & app.)	3.7	7
806261038	Inspector, missile	(aircraft mfg.)	4.0	7
825381026	Electrical inspector	(aircraft mfg.; air trans.)	3.3	7
806281026	Inspector, precision assembly	(aircraft mfg.)	3.7	7
806261034	Inspector, material disposition	(aircraft mfg.)	4.0	7
822261026	Testing-and-regulating technician	(tel. & tel.)	3.3	7
822361010	Cable tester	(tel. & tel.)	3.3	7
806261042	Inspector, outside production	(aircraft mfg.)	4.0	7
722381014	Instrument inspector	(aircraft mfg.; air trans.)	3.7	7
806261030	Inspector, assemblies and installations	(aircraft mfg.)	4.0	7
806261046	Inspector, plastics and composites	(aircraft mfg.)	4.0	7
822361[illegible]6	Transmission tester	(tel. & tel.)	3.3	7
609361010	Inspector, floor	(machine shop)	3.0	6
600281014	Lay-out inspector	(machine shop)	3.7	6
822361030	Trouble locator, test desk	(tel. & tel.)	3.0	6
726361018	Group leader, printed circuit board quality control	(electron. comp.)	3.0	6
806361022	Inspector, fabrication	(aircraft mfg.)	3.7	6
729381010	Electrical-equipment tester	(aircraft mfg.)	3.0	6
710381034	Calibrator	(inst. & app.)	3.3	6
806381074	Inspector, processing	(aircraft mfg.)	3.0	5
726685034	Leak tester, semiconductor packages	(electron. comp.)	1.7	2
	Aircraft mechanics (OES 85323). Grouped by SVP.			
621281018	Airframe-and-power-plant mechanic apprentice	(air trans.)	4.0	7
807261010	Aircraft body repairer	(air trans.)	3.3	7
621261022	Experimental aircraft mechanic	(aircraft mfg.)	3.7	7
621281014	Airframe-and-power-plant mechanic	(aircraft mfg.; air trans.)	4.0	7
807381014	Bonded structures repairer	(aircraft mfg.)	2.7	6
806384038	Pressure sealer-and-tester	(aircraft mfg.)	2.7	4
621684014	Reclamation worker	(wholesale tr.)	2.3	4
807684018	Aircraft skin burnisher	(aircraft mfg.)	2.0	3
	Machinists (OES 89108). Grouped by SVP.			
600260022	Machinist, experimental	(machine shop)	3.7	8
714[illegible]81018	Machinist, motion-picture equipment	(motion picture; photo. appar.)	4.0	8
600260018	Model maker, firearms	(ordnance)	3.7	8
6932[illegible]1022	Rocket-motor mechanic	(aircraft mfg.)	4.0	7
600281010	Fluid-power mechanic	(any industry)	3.7	7
600280030	Machinist apprentice, automotive	(automotive ser.)	3.3	7
600280034	Machinist, automotive	(automotive ser.)	3.3	7
600380010	Fixture maker	(light. fix.)	3.3	7
600280026	Machinist apprentice	(machine shop)	4.0	7
600280042	Maintenance machinist	(machine shop)	3.7	7
600280022	Machinist	(machine shop)	4.0	7
	Numerical machine tool operators and tenders, metal (OES 91502). Grouped by SVP.			
606382014	Jig-boring machine operator, numerical control	(machine shop)	3.7	7
617280010	Shot-peening operator	(aircraft mfg.)	3.7	6
604362010	Lathe operator, numerical control	(machine shop)	3.3	6
605380010	Milling-machine set-up operator, numerical control	(machine shop)	3.0	6
606362010	Drill-press operator, numerical control	(machine shop)	3.0	6
605360010	Router set-up operator, numerical control	(machine shop)	3.3	6
609360010	Numerical control machine set-up operator	(machine shop)	3.7	6
606382026	Robotic machine operator	(aircraft mfg.)	2.7	5
609362010	Numerical control machine operator	(machine shop)	3.0	5
699362010	Automated cutting machine operator	(aircraft mfg.)	2.7	4
605382046	Numerical-control router operator	(aircraft mfg.; electron. comp.)	2.3	4
606382018	Numerical-control drill operator, printed circuit boards	(electron. comp.)	3.0	4

Table 6. Major OES employing aircraft and aerospace machine trades workers in Los Angeles County, employment by industry, 1988 and 1991

OES Code	OES Title	1988 Empl	1991 Empl	Percent change	Percent of OES Group 1991
83002	Precision inspectors, testers, graders.				
	Aircraft and Aerospace	3,705	3,222	−13	29.8
	Other High Technology	4,522	3,500	−22	32.3
	Search and Navigation Instruments (381)	2,071	1,573	−24	14.5
	Electronic Components (367)	1,040	811	−22	7.5
	Computer and Office Equipment (357)	564	325	−42	3.0
	Measuring and Controlling Devices (382)	371	293	−21	2.7
	Medical Instruments and Supplies (384)	187	293	−57	2.7
	Communications Equipment (366)	177	129	−27	1.2
	Other Manufacturing	3,058	2,667	−13	24.6
	Industrial Machinery NEC (359)	316	325	3	3.0
	Miscellaneous Plastics Products NEC (308)	210	210	0	1.9
	Screw Machine Products, Bolts, Etc. (345)	221	200	−10	1.8
	Women's and Misses' Outerwear (233)	141	178	26	1.6
	General Industrial Machinery (356)	178	159	−11	1.5
	Non-Manufacturing	1,653	1,436	−13	13.3
	Telephone Communications (481)	652	549	−16	5.1
	Research and Testing Services (873)	440	385	−13	3.6
	Miscellaneous Business Services (738)	264	246	−7	2.3
	Total	12,936	10,825	−16	
85323	Aircraft mechanics.				
	Aircraft and Aerospace	5,505	4,926	−11	63.5
	Non-Manufacturing	2,600	2,836	9	36.5
	Air Transportation, Scheduled (451)	2,091	2,275	9	29.3
	Airports, Flying Fields, and Services (458)	354	395	12	5.1
	Total	8,105	7,762	−4	
89108	Machinists.				
	Aircraft and Aerospace	3,656	3,195	−13	16.7
	Other High Technology	1,480	1,128	−24	5.9
	Search and Navigation Instruments (381)	450	342	−24	1.8
	Measuring and Controlling Devices (382)	305	233	−24	1.2
	Electronic Components (367)	277	219	−21	1.1
	Medical Instruments and Supplies (384)	199	180	−10	0.9
	Other Manufacturing	12,057	11,344	−6	59.4
	Industrial Machinery NEC (359)	3,792	4,882	29	25.6
	Metalworking Machinery (354)	1,317	972	−26	5.1
	Screw Machine Products, Bolts, Etc. (345)	992	880	−11	4.6
	General Industrial Machinery (356)	717	536	−25	2.8
	Special Industrial Machinery (355)	502	423	−16	2.2
	Electric Lighting and Wiring Equipment (364)	588	366	−38	1.9
	Motor Vehicles and Equipment (371)	345	296	−14	1.6
	Miscellaneous Fabricated Metal Products (349)	355	259	−27	1.4
	Fabricated Structural Metal Products (344)	279	248	−11	1.3
	Miscellaneous Plastics Products NEC (308)	241	241	−0	1.3
	NonManufacturing	3,947	3,428	−13	18.0
	Automotive Repair Shops (753)	703	646	−8	3.4
	Miscellaneous Repair Shops (769)	473	467	−1	2.4
	Motor Vehicles, Parts, and Supplies (501)	459	452	−2	2.4
	Machinery, Equipment, and Supplies (508)	289	238	−18	1.2
	Total	21,140	19,095	−10	
91502	NC machine tool operators and tenders.				
	Aircraft and Aerospace	1,726	1,507	13	41.4
	Other High Technology	465	342	26	9.4
	Other Manufacturing	2,030	1,791	−12	49.2
	Industrial Machinery NEC (359)	702	902	−28	24.8
	Total	4,221	3,640	−14	

Table 7. OES groups including machine trades DOT titles with SVP of 6 or more
[Los Angeles County Employment in 1988 and 1991]

OES Code		1988 Empl	1991 Empl	Percent Change
93956	Assemblers and fabricators, except machine, electrical	50,235	41,091	−18
85132	Maintenance repairers, general utility	33,954	30,358	−11
89108	Machinists	21,140	19,095	−10
85302	Automotive mechanics	20,741	18,670	−10
81008	Supervisors, production	21,212	18,468	−13
83005	Precision inspectors, testers, graders, sorters	14,322	12,373	−14
81002	Supervisors, mechanics	13,656	12,349	−10
83002	Precision inspectors, testers, graders	12,938	10,825	−16
85999	all other mechanics, installers, repairers	12,616	10,663	−15
93999	All other hand workers	13,297	9,328	−30
85323	Aircraft mechanics	8,105	7,762	−4
85311	Bus and truck mechanics and diesel engine specialists	8,174	7,352	−10
31314	Teachers and instructors, voc ed and training	7,077	7,257	3
98102	Helpers, mechanics and repairers	7,222	6,351	−12
92998	All other machine operators and tenders	7,066	6,169	−13
81005	Supervisors, construction	6,341	6,145	−3
97702	Aircraft pilots and flight engineers	4,626	5,124	11
91117	Machine tool cutting operators and tenders, metals and plastic	5,476	4,540	−17
91321	Forming machine operators and tenders, metal and plastic	5,556	4,466	−20
85705	Data processing equipment repairers	3,893	4,357	12
85902	Heating, refrigeration, air conditioning mechanics	4,780	4,215	−12
81017	Supervisors, helpers and laborers	4,504	4,148	−8
89102	Tool and die makers	4,742	3,924	−17
89311	Cabinetmakers and bench carpenters	4,440	3,695	−17
91502	Numerical control machine tool operators and tenders, metal	4,221	3,640	−14
92543	Printing press machine operators and tenders	3,687	3,503	−5
92997	All other machine setters and set-up operators	4,937	3,414	−31
91114	Grinding, lapping, buffing machine tool setters and set-up operators	3,603	3,347	−7
92512	Offset lithographic press setters and set-up operators	3,384	3,276	−3
92965	Crushing, grinding, mixing, blending machine operators and tenders	3,485	3,178	−9
91105	Lathe and turning machine tool setters and set-up operators	3,724	3,158	−15
92198	All other metal and plastic machine workers	3,382	3,001	−11
89999	All other precision workers	4,246	2,949	−31
92705	Textile machine operators and tenders	3,434	2,732	−20
89308	Wood machinists	3,164	2,515	−21
91302	Punching machine setters and set-up operators	3,031	2,512	−17
85118	Machinery maintenance mechanics, power generation	2,411	2,500	4
91108	Drilling and boring machine tool setters and set-up operators	2,320	2,077	−10
92197	All other metal and plastic machine workers	2,175	1,903	−13
92944	Cutting and slicing machine operators and tenders	2,050	1,900	−7
89111	Tool grinders, filers, sharpeners	2,044	1,899	−7
85314	Mobile heavy equipment mechanics, except engines	2,133	1,815	−15
91305	Press and press-brake machine setters and set-up operators	2,016	1,701	−16
91714	Metal fabricators, structural metal products	1,844	1,505	−18
92541	Typesetting and composing machine operators and tenders	1,451	1,323	−9
92524	Screen printing machine setters and set-up operators	1,147	1,284	12
	Total	360,002	313,857	−13

Table 8. Cluster of DOT titles with skills-related characteristics similar to machinists
[Based on SVP, GED, Worker Functions, Materials and Products Sorted by Industry]

DOT Code	DOT Title	Industry	Average GED	Average SVP
624281010	Farm-equipment mechanic I	(agric. equip.)	3.3	7
624281014	Farm-equipment-mechanic apprentice	(agric. equip.)	3.3	7
621261010	Airplane inspector	(air trans.)	4.0	8
621261018	Flight engineer	(air trans.)	4.0	7
621281018	Airframe-and-power-plant-mechanic apprentice	(air trans.)	4.0	7
807261010	Aircraft body repairer	(air trans.)	3.3	7
824281010	Airport electrician	(air trans.)	3.7	7
002261014	Research mechanic	(aircraft mfg.)	4.0	7
621261022	Experimental aircraft mechanic	(aircraft mfg.)	3.7	7
621281030	Rocket-engine-component mechanic	(aircraft mfg.)	4.0	7
693261014	Development mechanic	(aircraft mfg.)	4.0	7
693261018	Model maker	(aircraft mfg.)	4.0	7
693261022	Rocket-motor mechanic	(aircraft mfg.)	4.0	7
693281030	Tool builder	(aircraft mfg.)	4.0	7
726261014	Electrician, research	(aircraft mfg.)	3.7	7
777281018	Patternmaker, plaster	(aircraft mfg.)	4.0	7
806261022	Tester, rocket motor	(aircraft mfg.)	4.0	8
806261030	Inspector, assemblies and installations	(aircraft mfg.)	4.0	7
806261034	Inspector, material disposition	(aircraft mfg.)	4.0	7
806261038	Inspector, missile	(aircraft mfg.)	4.0	7
806261042	Inspector, outside production	(aircraft mfg.)	4.0	7
806261046	Inspector, plastics and composites	(aircraft mfg.)	4.0	7
806261050	Operational test mechanic	(aircraft mfg.)	3.3	8
806281026	Inspector, precision assembly	(aircraft mfg.)	3.7	7
809261010	Assembler, ground support equipment	(aircraft mfg.)	3.3	7
825281038	Experimental-rocket-sled mechanic	(aircraft mfg.)	3.3	7
869261026	Wind tunnel mechanic	(aircraft mfg.)	4.0	7
621261014	Engine tester	(aircraft mfg.; air trans.)	4.0	7
621281014	Airframe-and-power-plant mechanic	(aircraft mfg.; air trans.)	4.0	7
825261018	Electrician, aircraft	(aircraft mfg.; air trans.)	3.3	7
600280010	Instrument maker	(any industry)	3.7	7
600280018	Instrument-maker apprentice	(any industry)	3.7	7
600281010	Fluid-power mechanic	(any industry)	3.7	7
616260014	Multi-operation-forming-machine setter	(any industry)	3.3	7
619261010	Inspector, metal fabricating	(any industry)	4.0	7
620281018	Automotive-maintenance-equipment servicer	(any industry)	3.3	7
620281050	Mechanic, industrial truck	(any industry)	3.3	7
625281010	Diesel mechanic	(any industry)	3.3	7
625281014	Diesel-mechanic apprentice	(any industry)	3.3	7
630281010	Pneumatic-tool repairer	(any industry)	3.3	7
630281030	Rubberizing mechanic	(any industry)	3.3	7
633281010	Cash-register servicer	(any industry)	3.3	7
633281014	Dictating-transcribing-machine servicer	(any industry)	3.3	7
633281018	Office-machine servicer	(any industry)	3.3	7
633281022	Office-machine-servicer apprentice	(any industry)	3.3	7
633281026	Scale mechanic	(any industry)	3.3	7
633281030	Statistical-machine servicer	(any industry)	3.3	7
637261018	Gas-appliance servicer	(any industry)	3.3	7
637261026	Refrigeration mechanic	(any industry)	3.3	8
637261034	Air and hydronic balancing technician	(any industry)	3.3	7
637281014	Stoker erector-and-servicer	(any industry)	3.3	7
638261030	Machine repairer, maintenance	(any industry)	4.0	7
638281014	Maintenance mechanic	(any industry)	3.7	7
638281018	Millwright	(any industry)	3.3	7
638281022	Millwright apprentice	(any industry)	3.3	7
638281026	Parts salvager	(any industry)	3.3	7
710261010	Instrument repairer	(any industry)	3.7	8
710281026	Instrument mechanic	(any industry)	3.7	7
721281018	Electric-motor repairer	(any industry)	3.3	7
726261010	Electronics assembler, developmental	(any industry)	4.0	7
726261018	Electronics tester	(any industry)	3.7	7
730281014	Accordion repairer	(any industry)	3.3	7
779281010	Clay modeler	(any industry)	3.7	7
804281010	Sheet-metal worker	(any industry)	3.7	7
804281014	Sheet-metal-worker apprentice	(any industry)	3.7	7
809281010	Lay-out worker I	(any industry)	3.7	8
821261014	Line maintainer	(any industry)	3.7	7
822281018	Maintenance mechanic, telephone	(any industry)	3.7	7
823261030	Data communications technician	(any industry)	3.7	7

Table 8. Cluster of DOT titles with skills-related characteristics similar to machinists—Continued
[Based on SVP, GED, Worker Functions, Materials and Products Sorted by Industry]

DOT Code	DOT Title	Industry	Average GED	Average SVP
823281014	Electrician, radio	(any industry)	3.7	7
823281018	Meteorological-equipment repairer	(any industry)	3.3	7
825261014	Elevator examiner-and-adjuster	(any industry)	3.3	8
825281030	Elevator repairer	(any industry)	3.3	7
825281034	Elevator-repairer apprentice	(any industry)	3.3	7
827261010	Electrical-appliance servicer	(any industry)	3.3	7
827261014	Electrical-appliance-servicer apprentice	(any industry)	3.3	7
828261022	Electronics mechanic	(any industry)	4.0	7
828261026	Electronics-mechanic apprentice	(any industry)	4.0	7
829261018	Electrician, maintenance	(any industry)	4.0	8
869281010	Furnace installer-and-repairer, hot air	(any industry)	3.3	7
899261014	Maintenance repairer, industrial	(any industry)	3.7	8
600280030	Machinist apprentice, automotive	(automotive ser.)	3.3	7
600280034	Machinist, automotive	(automotive ser.)	3.3	7
620261010	Automobile mechanic	(automotive ser.)	3.3	7
620261012	Automobile-mechanic apprentice	(automotive ser.)	3.3	7
620261014	Automobile tester	(automotive ser.)	3.3	7
620261018	Automobile-repair-service estimator	(automotive ser.)	3.3	7
620261034	Automotive-cooling-system diagnostic technician	(automotive ser.)	3.3	7
620281030	Bus inspector	(automotive ser.)	4.0	7
620281058	Tractor mechanic	(automotive ser.)	3.3	7
620281066	Tune-up mechanic	(automotive ser.)	3.3	7
825281022	Electrician, automotive	(automotive ser.)	3.3	7
601281030	Tool and fixture repairer	(auto. mfg.)	4.0	7
629281010	Bakery-machine mechanic	(bakery products)	3.3	7
788261010	Orthopedic-boot-and-shoe designer and maker	(boot & shoe; protective dev.)	3.7	7
628281010	Machine fixer	(carpet & rug)	3.7	7
630261010	Maintenance mechanic, compressed-gas plant	(chemical)	3.3	7
630281034	Service mechanic, compressed-gas equipment	(chemical)	3.3	7
601280034	Tap-and-die-maker technician	(clock & watch)	3.3	8
604260010	Screw-machine set-up operator, swiss-type	(clock & watch)	3.3	7
619280018	Spring-manufacturing set-up technician	(clock & watch)	4.0	7
715221010	Instructor, watch assembly	(clock & watch)	3.7	7
715261010	Mechanical technician, laboratory	(clock & watch)	4.0	7
715281010	Watch repairer	(clock & watch)	3.3	8
715281014	Watch repairer apprentice	(clock & watch)	3.3	8
637261010	Air-conditioning installer-servicer, window unit	(construction)	3.3	8
637261014	Heating-and-air-conditioning installer-servicer	(construction)	3.3	7
824261010	Electrician	(construction)	3.7	7
824261014	Electrician apprentice	(construction)	3.7	7
620281046	Maintenance mechanic	(construction; petrol. & gas; pipe lines).	3.3	7
824281014	Electric-distribution checker	(construction; utilities)	3.3	8
693281022	Patternmaker, sample	(cutlery-hrdwr.)	4.0	7
629281018	Dairy-equipment repairer	(dairy products)	3.3	7
629261022	Electronic-production-line-maintenance mechanic	(electron. comp.)	4.0	7
823261014	Radio interference investigator	(electron. comp.)	3.7	7
828281026	Computerized environmental control installer	(electron. comp.)	4.0	7
721261014	Final tester	(elec. equip.)	3.3	7
600261010	Assembler, steam-and-gas turbine	(engine-turbine)	3.3	8
623261010	Experimental mechanic, outboard motors	(engine-turbine)	4.0	7
625261010	Diesel-engine tester	(engine-turbine)	3.3	7
625281018	Engine repairer, service	(engine-turbine)	3.3	7
806261010	Internal-combustion-engine inspector	(engine-turbine)	3.7	7
638261014	Machinery erector	(engine-turbine; machinery mfg.).	4.0	8
623281038	Motorboat mechanic	(engine-turbine; ship-boat mfg.)	[illegible]	7
623281042	Outboard-motor mechanic	(engine-turbine; ship-boat mfg.)	3.3	7
626261010	Forge-shop-machine repairer	(forging)	3.3	7
600280046	Patternmaker apprentice, metal	(foundry)	3.7	8
600280050	Patternmaker, metal	(foundry)	3.7	8
661281018	Patternmaker apprentice, wood	(foundry)	3.7	8
661281022	Patternmaker, wood	(foundry)	3.7	8
693281018	Patternmaker, metal, bench	(foundry)	3.7	8
693280014	Patternmaker, all-around	(foundry; plastic prod.)	3.7	8
006261010	Scientific glass blower	(glass products)	4.0	8
504281010	Heat-treat inspector	(heat treating)	3.3	7
600280054	Sample maker, appliances	(house. appl.; light. fix.)	3.3	8

Table 8. Cluster of DOT titles with skills-related characteristics similar to machinists—Continued
[Based on SVP, GED, Worker Functions, Materials and Products Sorted by Industry]

DOT Code	DOT Title	Industry	Average GED	Average SVP
71028*J18	Electromechanical technician	(inst. & app.)	4.0	7
711261014	Instrument mechanic, weapons system	(inst. & app.)	3.3	8
865261014	Mechanical-test technician	(inst. & app.)	3.3	7
693260018	Engineering model maker	(inst. & app.; office machines)	4.0	8
199281010	Gemologist	(jewelry-silver.)	3.7	7
700281010	Jeweler	(jewelry-silver.)	3.3	7
700281014	Jeweler apprentice	(jewelry-silver.)	3.3	7
700281018	Model maker I	(jewelry-silver.)	3.3	7
620281042	Logging-equipment mechanic	(logging)	3.3	7
600260022	Machinist, experimental	(machine shop)	3.7	8
600280022	Machinist	(machine shop)	4.0	7
600280026	Machinist apprentice	(machine shop)	4.0	7
600280042	Maintenance machinist	(machine shop)	3.7	7
600281018	Lay-out worker	(machine shop)	3.7	7
601260010	Tool-and-die maker	(machine shop)	4.0	8
601260014	Tool-and-die-maker apprentice	(machine shop)	4.0	8
601261010	Inspector, set-up and lay-out	(machine shop)	4.0	8
601280010	Die maker, stamping	(machine shop)	4.0	8
601280014	Die maker, trim	(machine shop)	3.7	7
601280018	Die maker, wire drawing	(machine shop)	3.7	7
601280022	Die sinker	(machine shop)	3.3	7
601280030	Mold maker, die-casting and plastic molding	(machine shop)	3.3	7
601280038	Template maker, extrusion die	(machine shop)	4.0	7
601280042	Tool maker	(machine shop)	3.7	7
601280054	Tool-machine set-up operator	(machine shop)	3.7	7
601280058	Tool-maker apprentice	(machine shop)	3.7	7
601281010	Die maker, bench, stamping	(machine shop)	4.0	7
601281014	Die-try-out worker, stamping	(machine shop)	3.3	7
601281018	Inspector, gauge and instrument	(machine shop)	3.7	7
601281022	Inspector, tool	(machine shop)	4.0	8
601281026	Tool maker, bench	(machine shop)	3.3	7
602280010	Gear-cutting-machine set-up operator, tool	(machine shop)	3.7	7
603260010	Grinder set-up operator, thread tool	(machine shop)	3.7	7
603280010	Grinder operator, external, tool	(machine shop)	3.3	7
603280014	Grinder operator, surface, tool	(machine shop)	3.3	7
603280018	Grinder operator, tool	(machine shop)	3.7	7
603280022	Grinder set-up operator, internal	(machine shop)	3.3	7
603280026	Grinder set-up operator, jig	(machine shop)	3.7	7
603280030	Grinder set-up operator, universal	(machine shop)	3.7	7
603280038	Tool-grinder operator	(machine shop)	3.3	7
604280010	Engine-lathe set-up operator, tool	(machine shop)	4.0	7
604280014	Screw-machine set-up operator, multiple spindle	(machine shop)	3.3	8
604280018	Screw-machine set-up operator, single spindle	(machine shop)	3.3	7
604280022	Turret-lathe set-up operator, tool	(machine shop)	4.0	7
605280010	Milling-machine set-up operator I	(machine shop)	3.7	7
605280014	Profiling-machine set-up operator I	(machine shop)	3.3	7
605280018	Profiling-machine set-up operator, tool	(machine shop)	3.7	7
606280010	Boring-machine set-up operator, jig	(machine shop)	3.7	7
606280014	Boring-mill set-up operator, horizontal	(machine shop)	3.7	7
638261010	Automated equipment engineer-technician	(machinery mfg.)	4.0	7
638261026	Field service technician	(machinery mfg.)	4.0	7
801261010	Assembler, mining machinery	(machinery mfg.)	3.7	7
600281022	Machine builder	(machinery mfg.; machine tools).	3.7	7
638261018	Manufacturer's service representative	(machinery mfg.; machine tools).	3.3	8
616260018	Spring coiling machine setter	(metal prod., nec)	3.7	7
616260022	Torsion spring coiling machine setter	(metal prod., nec)	3.7	7
616280010	Spring maker	(metal prod., nec)	3.3	7
619260010	Ornamental-metal-worker apprentice	(metal prod., nec)	3.3	8
613260014	Ornamental-metal worker	(metal prod., nec)	3.3	8
693281014	Patternmaker	(metal prod., nec)	3.3	7
714281018	Machinist, motion-picture equipment	(motion picture; photo. appar.)	4.0	8
600260014	Experimental mechanic	(motor-bicycles)	3.7	8
806281014	Experimental mechanic, electrical	(motor-bicycles)	3.7	7
962261010	Planetarium technician	(museums)	4.0	7
730281010	Accordion maker	(musical inst.)	3.3	8
730281022	Fretted-instrument maker, hand	(musical inst.)	3.7	8

Table 8. Cluster of DOT titles with skills-related characteristics similar to machinists—Continued
[Based on SVP, GED, Worker Functions, Materials and Products Sorted by Industry]

DOT Code	DOT Title	Industry	Average GED	Average SVP
730281030	Harp maker	(musical inst.)	3.7	8
730281042	Pipe-organ builder	(musical inst.)	3.3	8
730281046	Violin maker, hand	(musical inst.)	3.3	8
683260018	Loom fixer	(narrow fabrics; nonmet. min.; textile).	3.3	7
612260010	Fastener technologist	(nut & bolt)	3.3	7
690280010	Deburring-and-tooling-machine operator	(office machines)	3.7	8
711251010	Inspector, optical instrument	(optical goods)	4.0	7
713261014	Artificial-plastic-eye maker	(optical goods)	3.7	8
716280018	Optician	(optical goods)	4.0	8
716280010	Optician apprentice	(optical goods; retail trade)	4.0	8
716280014	Optician	(optical goods; retail trade)	4.0	8
549261010	Mechanical inspector	(petrol. refin.)	3.3	7
828281022	Ra[illegible] activity-instrument maintenance technician	(petrol. & gas)	4.0	7
714281010	Aircraft-photographic-equipment mechanic	(photo. appar.)	4.0	8
714281014	Camera repairer	(photo. appar.)	4.0	8
714281022	Photographic equipment technician	(photo. appar.)	4.0	8
714281026	Photographic-equipment-maintenance technician	(photo. appar.)	3.7	7
826261010	Field-service engineer	(photo. appar.)	3.7	8
828261018	Senior technician, controls	(pipe lines)	4.0	7
627261010	Composing-room machinist	(print. & pub.)	3.3	8
627261014	Machinist apprentice, composing room	(print. & pub.)	3.3	8
627261018	Machinist apprentice, linotype	(print. & pub.)	3.3	7
627261022	Machinist, linotype	(print. & pub.)	3.3	7
979281010	Die maker	(print. & pub.)	3.3	7
979281018	Engraver, picture	(print. & pub.)	3.3	8
828261014	Field service engineer	(profess. & kin.)	4.0	7
822281030	Technician, plant and maintenance	(radio-tv broad.)	3.3	7
823281022	Rigger	(radio-tv broad.)	3.3	7
622281010	Locomotive inspector	(railroad equip.)	3.3	7
825281026	Electrician, locomotive	(railroad equip.)	3.3	7
822281026	Signal maintainer	(r.r. trans.)	3.3	7
825261010	Electric-track-switch maintainer	(r.r. trans.)	3.7	7
638281030	Hydraulic-rubbish-compactor mechanic	(sanitary ser.)	3.3	8
623281018	Machinist apprentice, marine engine	(ship-boat mfg.)	3.3	7
623281022	Machinist apprentice, outside	(ship-boat mfg.)	3.3	7
623281026	Machinist, marine engine	(ship-boat mfg.)	3.3	7
623281030	Machinist, outside	(ship-boat mfg.)	3.3	7
661281010	Loft worker	(ship-boat mfg.)	3.7	7
661281014	Loft worker apprentice	(ship-boat mfg.)	3.7	7
806261026	Marine-services technician	(ship-boat mfg.)	3.3	7
806281058	Carpenter, prototype	(ship-boat mfg.)	3.3	7
862261010	Pipe fitter	(ship-boat mfg.)	3.7	7
869281018	Yard inspector	(ship-boat mfg.)	3.3	7
630281026	Repairer	(smelt. & refin.)	3.3	7
011261022	Laboratory assistant, metallurgical	(steel & rel.)	4.0	7
771281014	Stone carver	(stonework)	4.0	8
775281010	Surface-plate finisher	(stonework)	3.7	7
805261010	Boilermaker apprentice	(struct. metal)	3.7	7
805261014	Boilermaker I	(struct. metal)	3.7	7
722281010	Instrument repairer	(tel. & tel.)	3.3	7
822261010	Electrician, office	(tel. & tel.)	3.3	7
822261014	Equipment inspector	(tel. & tel.)	3.7	8
822261018	Maintenance inspector	(tel. & tel.)	3.3	8
822261022	Station installer-and-repairer	(tel. & tel.)	3.7	7
822261026	Testing-and-regulating technician	(tel. & tel.)	3.3	7
822281010	Automatic-equipment technician	(tel. & tel.)	3.7	7
822281014	Central-office repairer	(tel. & tel.)	3.3	7
822281034	Technician, submarine cable equipment	(tel. & tel.)	3.7	7
731280010	Model maker	(toy-sport equip.)	4.0	7
732281010	Custom ski maker	(toy-sport equip.)	4.0	7
631261010	Hydroelectric-machinery mechanic	(utilities)	3.3	7
631261014	Powerhouse mechanic	(utilities)	3.3	8
631261018	Powerhouse-mechanic apprentice	(utilities)	3.3	8
637261022	Industrial-gas servicer	(utilities)	3.3	7
710281030	Instrument technician	(utilities)	3.3	8
710281042	Instrument-technician apprentice	(utilities)	3.3	8
724281010	Transformer tester	(utilities)	3.3	7
729281034	Inside-meter tester	(utilities)	3.3	7

Table 8. Cluster of DOT titles with skills-related characteristics similar to machinists—Continued
[Based on SVP, GED, Worker Functions, Materials and Products Sorted by Industry]

DOT Code	DOT Title	Industry	Average	
			GED	SVP
729281038	Relay tester	(utilities)	3.7	7
820261010	Electrician apprentice, powerhouse	(utilities)	3.7	8
820261014	Electrician, powerhouse	(utilities)	3.7	8
820261018	Electrician, substation	(utilities)	3.7	8
821261018	Relay technician	(utilities)	3.7	8
821261026	Trouble shooter II	(utilities)	3.7	8
829261010	Complaint inspector	(utilities)	3.3	7
952261010	Substation inspector	(utilities)	3.3	7
623281010	Deck engineer	(water trans.)	3.3	7
626261014	Repairer, welding systems and equipment	(welding)	4.0	7
819281010	Lead burner	(welding)	3.3	7
819281014	Lead-burner apprentice	(welding)	3.3	7
819281018	Weld inspector I	(welding)	3.7	7

Table 9. Machine shop DOT titles with skills-related characteristics similar to machinists

DOT Code	DOT Title	Average	
		GED	SVP
600260022	Machinist, experimental	3.7	8
600280022	Machinist	4.0	7
600280026	Machinist apprentice	4.0	7
600280042	Maintenance machinist	3.7	7
600281018	Lay-out worker	3.7	7
601260010	Tool-and-die maker	4.0	8
601260014	Tool-and-die-maker apprentice	4.0	8
601261010	Inspector, set-up and lay-out	4.0	8
601280010	Die maker, stamping	4.0	8
601280014	Die maker, trim	3.7	7
601280018	Die maker, wire drawing	3.7	7
601280022	Die sinker	3.3	7
601280030	Mold maker, die-casting and plastic molding.	3.3	7
601280038	Template maker, extrusion die	4.0	7
601280042	Tool maker	3.7	7
601280054	Tool-machine set-up operator	3.7	7
601280058	Tool-maker apprentice	3.7	7
601281010	Die maker, bench, stamping	4.0	7
601281014	Die-try-out worker, stamping	3.3	7
601281018	Inspector, gauge and instrument	3.7	7
601281022	Inspector, tool	4.0	8
601281026	Tool maker, bench	3.3	7
602280010	Gear-cutting-machine set-up operator, tool.	3.7	7
603260010	Grinder set-up operator, thread tool	3.7	7
603280010	Grinder operator, external, tool	3.3	7
603280014	Grinder operator, surface, tool	3.3	7
603280018	Grinder operator, tool	3.7	7
603280022	Grinder set-up operator, internal	3.3	7
603280026	Grinder set-up operator, jig	3.7	7
603280030	Grinder set-up operator, universal	3.7	7
603280038	Tool-grinder operator	3.3	7
604280010	Engine-lathe set-up operator, tool	4.0	7
604280014	Screw-machine set-up operator, multiple spindle.	3.3	8
604280018	Screw-machine set-up operator, single spindle.	3.3	7
604280022	Turret-lathe set-up operator, tool	4.0	7
605280010	Milling-machine set-up operator I	3.7	7
605280014	Profiling-machine set-up operator I	3.3	7
605280018	Profiling-machine set-up operator, tool	3.7	7
606280010	Boring-machine set-up operator, jig	3.7	7
606280014	Boring-mill set-up operator, horizontal	3.7	7

Part II. The Future SOC

Principles and Goals

Building on the discussion of public interests, limitations of the current SOC/DOT systems and approaches to occupational classification in Part I of this report, Part II offers recommendations for creating the future SOC and describes the role of the SOC/DOT in assisting workers within a continuously changing economy.

Overview

• The future SOC should be shaped to provide information that will help achieve high priority social goals for the workforce.

The central goals of the SOC should be made explicit and used as templates to guide the design, production, and use of the system. If goals are not articulated, then the process will be shaped by other interests, including, for example, the divergent missions of different government agencies.

The historical and institutional legacy counts as both a constraint and an opportunity. On one hand, time and energy devoted over the years to the existing DOT/SOC systems means that any radical change would represent an abandonment of a substantial investment, and thus is not to be considered lightly. The existence of related classification systems (notably the Census and the OES) and work programs designed by users to incorporate the DOT/SOC also serve as a constraint to changes. On the other hand, the existing DOT/SOC with its great wealth of occupational data, and the collective experience of staff and users, offers opportunities for more effective utilization that are too important to neglect. The institutional infrastructure includes many field offices with detailed local knowledge, as well as a large body of users. The emergence of information processing technology, now accessible enough for widespread use, will allow average users to make full use of the range of information collected in the DOT.

Another important constraint is deep public concern about the level of government spending and the corresponding climate of fiscal restraint. This may be mitigated by the commitment of the current administration to worker retraining and education, government programs to stimulate economic growth, and creation of a climate in which the importance of occupational information is recognized.

New computer technologies present an opportunity for introducing a number of innovations, including transforming the DOT from a dictionary into a database, allowing users to generate their own nested hierarchies of occupations, linking databases, and displaying and analyzing geographic data.

The SOC system is a valuable information resource. In an economy experiencing deep restructuring, where entire industries are relocating outside national borders, and where individuals must expect to make several major job changes over the course of their working lives, information on occupational structure is a strategic tool. In the task of revising the SOC, the selection of data items and the design of the system are opportunities to make it a more powerful tool. But the selections to be made depend on judgements about the ends to be served by occupational information, and about *who* should use the information to achieve those ends. This study focuses primarily on the societal goals of helping people find satisfying and productive work. What then are the information needs of workers and those who counsel them in education and job placement? How can that information be supplied in a way that is most accessible to workers and gives them more control over job selection?

An occupational information system should provide workers with information which gives them a good sense of the *labor market terrain* in a changing economy. They should be able to "locate" their current occupation and see its relationship to similar kinds of work. They should also have current information on the size and growth rates of their occupation and the industry in which they work, preferably at the scale of the local labor market.

Workers in a variety of situations (displaced workers, new entrants to the labor market, those with particular disadvantages) all share an interest in occupational information that specifies particular requirements controlling entry into an occupation. In other words, workers have an interest in identifying the "gates" that restrict occupational mobility when these gates can be unlocked by the "keys" of education, training and experience. Other factors (such as interests, and general abilities, for example, problem-solving) may affect the extent to which a person succeeds in or enjoys the work, but they do not generally serve as gates by which potential entrants are screened out.[5] Hence broad measures of *skill level* can indicate the pathway that a worker needs to follow to reach an occupational goal.

Workers satisfied with their field of work will usually develop a good understanding of the upward mobility possible for them. But those searching for a new field of work (dislocated from a declining, relocating, or restructuring industry) need to identify alternative occupations using the skills and experience they have. Information on *skills transferability* is essential for effective horizontal mobility; the occupational classification system should provide a user-friendly basis for linking occupations on the basis of similar skills.

Historical, cultural and institutional practices influence the entry of individuals into particular occupations. Workers need to know the *social barriers* to occupational mobility as well as the formal requirements of education and training. For example, if applicants for a certain

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occupation are routinely required to have a high school diploma although the work itself does not require that level of education, that represents an entry barrier. Information on actual mobility patterns can be a useful empirical indicator of skill transferability. However, it is important to differentiate as far as possible between objective requirements and custom, so that discriminatory practices can be challenged and job opportunities made more accessible.

A key aspect of an occupation, with wide implications, is the degree of *authority and control* over one's own work and the work of others. It is a central feature of the kind of work performed, and may become more important in distinguishing occupations, as specialized, craft-related knowledge declines in response to the rapid pace of technological change. The two broad principles and related societal goals proposed for the future SOC are:

Empower workers by giving them access to useful occupational information. This is the central future purpose recommended for the DOT/SOC.

- Help displaced workers transfer their skills to new jobs.
- Identify essential competencies that students or workers need to master to qualify for jobs.
- Make optimal matches between workers and jobs.
- Help people with barriers to employment get jobs.
- Identify career advancement opportunities for workers.
- Help workers make job and career choices that serve their best interests.
- Provide current labor market information.

Contribute to good public policy development by providing the tools for policy analysis and research. This is a secondary purpose of the DOT/SOC.

- Improve the quality of labor market projections.
- Allow occupational and socio-economic information to be related.
- Make possible historical analysis of occupational trends.
- Make possible international comparisons of occupational composition.
- Improve medical research into occupational illness and injuries.
- Improve sociological research into education, class and related issues.

Reliable, up-to-date occupational and labor market information can contribute to these goals. These societal goals underlie the specific recommendations for the future SOC that are presented in the following section.

Recommendations for the Future SOC

The recommendations for the future SOC cover issues of system structure, information content, and application. Particular attention is given to streamlining the occupational classification system; emphasizing skills, authority, and work fields in choosing variables and classifying occupations; and making occupational and labor market information more compatible and widely used.

Core Recommendations:

Structure:	Integrate the DOT and SOC into a single system in which the SOC provides occupational information, with additional and more detailed information provided at the DOT level.
Content:	Classify occupations on the basis of skills, authority, and work fields.
Uses:	Simplify the connection between occupational, labor market, social and demographic information by using the revised SOC unit group as the main occupational unit.

Recommendations on structure

Core Recommendation One: Integrate DOT and SOC into a single system that is technically and conceptually compatible.

- Combine the DOT and SOC so they share a common classification structure. Retain the DOT title as the most detailed occupational unit. For the next level of aggregation, cluster similar DOT titles into new groups equivalent to the SOC unit group. Use a single structure for further levels of aggregation.
- Combine DOT and SOC operations for data collection, maintenance, and publication.

Historically, the DOT has been conceived primarily as a dictionary rather than a classification system. In other words, the focus has been on the individual title definition, rather than on the structure of the nested hierarchy of occupational aggregations and the function of the system as a whole. Given this perspective, it is understandable that many users comment on its unwieldy size and inconsistency across industrial sectors. Over time, the demand has grown for more aggregate occupational information, and for the capacity to link occupational information to other databases using a common occupational unit as a base. In addition, the wider use of computers that can store and sort the entire DOT database has stimulated interest in the structure of the system

as a whole and the potential for alternative methods of aggregation.

The existing SOC represents an initial response to some of these demands. However, the continuing existence of two sets of nested hierarchies in the DOT and SOC, both based on "type of work performed," has led to confusion and inefficiency. In addition, the separate publication, dissemination, review and revision of the SOC has meant that many DOT users were unaware that the SOC even existed. Given that a thorough revision of both systems is currently being proposed, there are strong reasons to integrate the two into a single system. A simpler and more powerful system would be more widely used, and wider use would in turn strengthen the system.

A useful model in this regard is the Standard Industrial Classification or SIC. Industries are classified into categories at various levels of specificity, ranging from one digit to four and even in some cases five- or six-digit units. The system of nested levels of specificity is well-understood, and the appropriate level can be selected depending on user needs. The simplicity and power of the system has meant that it is widely used by nongovernmental agencies; for example, the commercially published registers of manufacturing firms use the code.

In this proposed integrated system, the DOT would still retain its function as a dictionary. In other words, it would still be the repository of the most detailed information on an occupation at the most disaggregated form, and would contain lists of alternate titles so that ideally, any job could be located and classified.

• *Define the SOC basic occupational unit (unit group) by specific variables (descriptor items) rather than only in terms of its component DOT titles.*

A SOC unit group should be defined in terms of the common characteristics shared by the component occupations, expressed in both verbal descriptions and where appropriate in terms of scores on selected measures. Information should be embedded in identifier codes. At present the numbering of the SOC code only refers to the system of nested hierarchies; it carries no information. There has been general approval of the concept of changing it to resemble the DOT code, where most digits represent scores for selected variables.

• ***Distinguish between sorting variables (to be used in defining occupations) and supplementary variables (to be part of a database) for both the DOT titles and the SOC basic units.***

The DOT and the SOC should use the same basic sorting variables in defining occupations, so that the titles grouped into SOC unit groups are essentially similar. However, the rating scales may be more specific for the DOT compared to the SOC, since the SOC unit groups will need to incorporate more diversity within a single group. So for example, the DOT may use a SVP metric with nine levels, while the SOC may use a simplified version of this with only four levels. The selection of variables is discussed in more detail in a later section.

• *Reduce the number of DOT titles. Acknowledge that the number of SOC unit group occupations and the number of DOT titles to be included in a revised system is the outcome of both strategic choice and objective evidence.*

Acceptance of both the dynamic nature of the labor market and the socially constructed character of occupations means that we acknowledge that there is no inherent "true" number of occupations. The number we choose to include in our system thus depends on our needs.

A review of the number of titles used in other countries in their comparable systems shows a wide variation in what has been considered necessary to cover their universe of jobs (see inset box). In some cases, it is evident that the cutoff was decided by the amount of resources (time, staff, money) available to handle the collection and processing of the information. The criticism of too many titles is evidently global, as many of the countries indicate a desire to reduce the volume of entries in their dictionary-type systems.

Since there is no consistent formal logic by which occupations are defined, the number of occupations defined in the DOT can reasonably be adjusted without abandoning consistency. The APDOT final report (APDOT, 1993) recommends a smaller number of occupations, but does not specify this apart from placing it in the range between the 12,000 of the DOT and the 600-plus of the SOC.

Number of occupations defined by other countries

Australia:	1,079 distinct occupations and 282 Unit Groups in the *Australian Standard Classification of Occupations* (ASCO) (Embury, 1991: 36).
Canada:	521 Unit Groups and 132 Minor Groups in the new *National Occupational Classification* (NOC) (Stevens, 1991: 25).
France:	8,600 occupational titles and 1,135 occupations in the *ROME (Repertoire operationnel de metier et emplois)* (Bertrand, 1991: 19).
Japan:	2,709 five-digit occupations and 395 three-digit occupations in the *Occupational Classification Table* (Permanent Mission of Japan, 1990).
Netherlands:	1,212 standard occupations in the CBS new system; 3,000 occupations in the I-SEE! systems used for job placement (Wootten, 1993: 16; Schoorlemmer and Meesters, 1992: 29).
United Kingdom:	371 Unit Occupations and 77 Minor Groups in the *Standard Classification of Occupations* (Behkendorf and Curry, 1992: 1–2).

Many users have claimed that the DOT contains an overwhelming number of occupations, making it difficult to use. Some of the problems currently experienced by users could be solved by making the DOT more accessible in a user-friendly computerized format, without necessarily cutting the number of titles. However, there are some reasonable arguments for improving the quality of the DOT information by reducing the number of titles:

By using skill level as a central component in the definition of occupations, rather than type of work performed, a greater degree of aggregation (especially of easily-learned jobs) is appropriate.

A smaller basic occupational listing, with fewer occupations distinguished solely on the basis of a detailed technical division of labor, will be less subject to obsolescence induced by technological change.

A smaller listing will also be less costly to maintain. Funds saved should be spent widening the sample of firms analyzed, to overcome some of the current problems with the representativeness of the DOT. If resources continue to be limited, a more frequent and fuller set of database information on a smaller number of occupations is better than less frequent information on a larger number of occupations.

A selective purging of occupations in certain manufacturing industries with an abundance of DOT titles (such as food and tobacco processing and tire manufacturing) would make the entire system more consistent by reducing the concentration of manufacturing titles.

By erasing relatively minor distinctions and grouping occupations into larger categories, job-seekers may find it easier to recognize potential jobs than if they were classified separately. The smaller number of categories may reduce errors by employment service staff in classifying job-seekers.

The loss of classification detail may hamper some work-seekers if they possess specialized skills or experience which are not recognized in a broader occupational definition. Grouping occupations together does mean that some detail is lost and specialized occupations tend to be absorbed into more generic groupings. For example, a braille keyboard operator might be grouped in with all other keyboard operators, even though she/he has a specialized skill. However, we should recognize that the use of the DOT/SOC is only one step in a job search, and more detailed information may be appropriate at other stages.

Although it may seem regressive to recommend a reduction in level of detail, this should be seen in the context of the entire system. Detailed specificity of occupational description is only one aspect of a comprehensive occupational classification system. Other aspects include consistent coverage of all industries or fields of work; consistent geographical coverage; and consistent updating. It is unwise to build into the system heavy demands for resources to ensure comprehensive and detailed coverage on only one of these aspects. Some suggestions on methods for reducing DOT titles are presented in a later section of this report (under Recommendations on Implementation).

• *Set the broad parameters for the total number of SOC unit groups with reference to the data needs and data collection capacities of the Census Bureau and the OES. Consider also the total number of categories in ISCO-88 and the Canadian systems.*

The Census currently uses 501 occupation groups in their occupational classification scheme, and the OES uses 756 occupation groups. This suggests that the optimal number of SOC unit group occupations lies in the range of 500 to 800.

The Census and the OES are both constrained by practical considerations such as the capacities of coders to make regular and consistent allocations with limited information. Further research is required on the impact of a change in the number of unit groups on programs that count the labor force. Given the significance of the SOC as the mediator between occupational description and labor market information, coordination between agencies on these issues is vital.

The uses of the revised SOC would be enhanced if the classification were approximately equivalent to other systems where comparisons are often sought. Canada's economy is closely intertwined with that of the United States, and its recently revised occupational system is highly regarded as a model for other nations. The new Canadian National Occupational Classification (NOC) defines 521 Unit Groups. The ability to match U.S. occupational classifications to the international standard (ISCO–88) is desirable to increase the potential for comparative research. ISCO–88 defines 390 occupations at the most detailed level; whereas there were 1,506 detailed occupations in ISCO–68.

• *Base the definitions of occupations on consistent principles.*

The DOT and the SOC both suffer from inconsistency in the level of specificity with which occupations are defined. The tendency in the DOT to define more distinct occupations for manufacturing than for service sector jobs is well recorded, but inconsistencies also occur within different industries. Some of these are reflected and amplified in the SOC. For example, there are several separate DOT titles referring to music instrument sales staff, while other kinds of specialized sales jobs are not differentiated in such detail. In turn, music instrument sales

occupations are grouped together to form a distinct SOC unit group, while SOC unit groups in other sales fields are less specific.

Using the same broad sorting variables in the initial process of generating SOC unit groups is one way of creating a consistent level of specificity. The final definition of a SOC unit group should be made by considering the particular circumstances of each case, but the issue of consistency within the major group, and across major groups, should be of prime consideration. The sorting variables which might be used as the basis for an initial aggregation are described in the Appendix.

Recommendations on content

Core recommendation two. Classify occupations on the basis of skills, authority, and work fields.

• *Use a combination of broad skill levels, authority, and work fields to construct a matrix of occupations.*

Occupations should be classified on the basis of skills, authority, and work fields. This marks a departure from the stated classifying principle of the DOT/SOC, which is to classify on the basis of "type of work performed." The "type of work" principle was shaped in part by a belief in the inherent dignity of all labor, leading to a rejection of an explicitly hierarchical classification system. This approach is appealing, and has the advantage of focussing attention on the nature of the work. However, it has some drawbacks. First, the classification system fails to reflect common-sense understandings of the hierarchical aspects of the world of work experienced by workers. In particular, it neglects the common perception that experience, education, and increased authority bring higher rewards, and in many cases are elements defining positions in a career ladder with successively greater rewards. By neglecting this aspect of common-sense knowledge of the labor market, the system risks being seen as irrelevant. Second, the potential of the occupational system to indicate career ladders and requirements (education, experience) limiting entry is constrained. For example, the DOT aggregation system groups together helpers and supervisors along with those doing the task. Third, despite its focus on type of work, the classification system does in practice incorporate implicit hierarchies of skill and authority in classifying occupations. As an illustration of this, the occupations classified as Professional have an SVP rating of 8, with only about a dozen exceptions. Despite its attempts to organize occupations in a non-hierarchical manner, the DOT/SOC structure does contain an inherent recognition of a skill/authority hierarchy, and is widely understood as such. The most aggregated groupings recognized by the SOC consist of 22 categories, ranging from Executive, Administrative, and Managerial Occupations to Handlers, Equipment Cleaners, Helpers, and Laborers.

By explicitly recognizing and incorporating the elements of (broadly defined) skill, authority, and field of work, the result will be a classification structure that contains job families with similar "types of work." By using principles of skill, authority and work field, main aspects of an occupation that are important to workers (and that usually govern remuneration) are incorporated into the basic design of an occupational classification system. In this way the occupational classification system may become more useful for job placement, career planning, job training, and research.

These dimensions indicate barriers to worker mobility, as well as possible mobility paths. Skill levels are established by hiring criteria based on educational achievement, certification, training, and seniority, depending on the occupation and organization. The degree of authority and control a worker has often indicates his or her place on career ladders. The work field shows horizontal barriers to mobility, and suggests the extent of skills transferability. Information on substantive skills can show which skills are transferable, and which ones are specific to an occupation or industry.

Skill, work field and authority are complex and multifaceted concepts that can not be covered by a simple definition and single measurement. Each is briefly described here, and selected aspects are covered in more detail in subsequent sections.

Skill. It is widely argued that skill should be given a high priority in the design of a revised DOT/SOC. From the national perspective, a high-skill economy offers the best outcome. From the worker perspective, the ability to make use of acquired skills offers the greatest potential for personal fulfillment and material returns. Knowledge about occupational skills, and requisite training and education, is critical to workers entering the labor market, or seeking to transfer skills across jobs and possibly across occupations. This information is especially important when jobs, occupations, and labor markets are transformed by organizations adapting to a changing economic environment.

Work field. Work field should be a second dimension along which occupational groups are determined. Work fields result from similar technological and organizational contexts within which a job is performed, as well as the products and services which are produced. In some cases work fields may be defined most strongly by industry, as in the case of work in a steel foundry or garment factory. In other cases, the technology used may be the major indicator of work field, as in the case of computer keyboard-entry occupations which are found across numerous industries. Work field is an indicator of the substantive knowledge accumulated by individuals about the object, tools, products and services with which they work. While a broad measure of skill may tell us "how much"

an individual knows, the work field tell us "what" he or she knows and does.

Authority. Authority refers to the degree of control an individual has over his or her own work and over that of others. The importance of this aspect is indicated in the existing DOT/SOC system by the separate classification of executives and managers, and the SOC practice of distinguishing supervisors from the people they supervise. The related dimensions of supervisory authority, responsibility, and autonomy have generally received little attention in the current debates on redesigning the classification system, although they are clearly relevant to the way that work is organized and rewarded, and they also reflect real differences in the lived experiences (for example, stress, job satisfaction) of individuals.

The use of skill, work field, and authority is similar to classification systems recently introduced recently in other nations. The new Canadian National Occupational Classification (NOC) consists of ten major groups defined on the basis of skill level and work field. Skill levels are based on a combination of education, training, and job experience. Three general occupations—Clerical, Administrative, and Regulatory; Sales and Services; and Industrial—are divided into skilled and semi-skilled occupation groups. The skilled occupation groups vary in their requirements for high school degrees, college degrees, apprenticeships, and job experience. The top skill level includes Managerial, Professional, and Technical Occupations, which typically require college degrees and significant specialized training. The lowest skill level includes Laboring and Elemental Occupations, comprised of entry-level jobs that require little if any job experience or education diplomas (Dixon, 1988).

ISCO–88 groups all occupations into four broad skill levels. Skill is defined as having two dimensions: skill level (a function of the complexity and range of the tasks involved) and skill specialization (the field of knowledge, the materials worked on or with, the tools and machinery used, and the kinds of goods and services produced). The skill levels refer to skills that may be acquired by formal education or informal training and experience. Education levels are specified separately. There are 10 major groups, and the highest skill level, the third highest, and the lowest each make up 1 major group. The second skill level (some high school, possibly some on-the-job training) is divided into five areas. The armed forces and "legislators/senior officials and managers" are not linked to skill levels.

An example of the basic structure of the occupational matrix generated by a consideration of these three items is shown in table 10. Note that this is merely a tentative model to serve as a point of discussion, rather than a final model. The final outcome would depend on consensus about the appropriate ways to divide the spectrum of work fields, skill, and authority.

Selection of variables. The choice of variables to be collected in job surveys and analyses is a critical classification decision which sets the potential range of "sorting variables" and determines opportunities for defining and aggregating occupations.

- *In choosing variables, incorporate the criticisms and suggestions generated by the various critical reviews of the occupational classification system in recent years.*

A review of the literature on the DOT revealed a number of commonly-voiced comments relevant to the selection of variables. First, the new variables should include better measures of important features of office-based and service sector employment. Second, cognitive requirements of occupations should be given greater attention. Third, variables that are useful in distinguishing higher-skill occupations should be included; those useful only for distinguishing lower-skill occupations may possibly be dropped. These three overlap to some extent, since office-based occupations are more difficult than fac-

Table 10. Occupation groups based on skill level, authority, and work fields

Skill level	Authority level	Work field	Comments
SVP 8–9	Managers and professionals		To include all jobs now in DOT Occupational Division 00/01
SVP 6–7	Supervisors and skilled workers	—Agriculture, fishing, forestry —Construction and extractive —Transport and utilities —Benchwork (craft) —Manufacturing —Administrative support —Sales —Service	To include all jobs now in SOC supervisor minor groups
SVP 4–5	Mid-level workers	Same work fields as above	
SVP 1–3	Entry-level workers	—Services —Manufacturing/agriculture/fishing/forestry —Sales/clerical	

tory-based occupations to describe in behavioral terms, leading to a consideration of cognitive activity.

There is no lack of suggestions as to potential variables for which data may be collected in an occupational classification system. Given the constraints imposed by the cost of information gathering, it is useful to establish a baseline or minimum list of essential variables. One source of this minimum list may be derived from the results of a factor analysis undertaken by the DOT review team (National Research Council, 1980). The main independent variables identified in this exercise are: substantive complexity, motor skills, physical demands, management skills, interpersonal skills, and undesirable working conditions.

Results of Factor Analysis of Fourth Edition DOT (National Research Council, 1980)

1. *Substantive complexity.* Includes GED and SVP, intelligence, complexity of functioning with data and people, numerical and verbal aptitude, and abstract/creative activities (among others).
2. *Motor skills.* Includes factors such as motor coordination, dexterity, complexity of functioning with things, form and spatial perception, and activities involving processes and machines (among others).
3. *Physical demands.* Includes location outside, and demands for stooping, climbing, strength and eye-hand coordination.
4. *Management.* Includes dealing with people, direction, control, planning, complexity functioning with people and data (among others).
5. *Interpersonal skills.* Includes sensory or judgmental criteria, influencing people, feelings.
6. *Undesirable working conditions.* Includes hazards, atmospheric discomfort, and extreme heat.

The APDOT final report (APDOT, 1993) describes a Content Model to serve as a framework for the new DOT which incorporates many of the user comments and research findings. The four main sections include Worker Attributes, Work Context, Work Content and Outcomes, and Labor Market Context. As stated in the report, it is not intended that information on all the components listed can or should be collected as part of a single job analysis instrument, or even as part of the job analysis program (APDOT 1993, p. 31). In particular, information on the labor market context and the attributes of workers are best collected through surveys or existing databases. For example, the association between worker aptitudes/interests and a particular job is best discovered through validation studies of aptitude tests, many of which have been done.

The question then arises: Which variables can be effectively collected as part of the job analysis process and so serve as sorting variables to define and distinguish separate occupations? This question appears to have received relatively little attention in the DOT revision to date, but it is central to the definition of occupations and requires making serious decisions about the best use of resources. In table 13 the variables identified in the APDOT Final Report are evaluated in terms of the feasibility of collecting them during job analysis, and their importance as input into the classification process. Table 13 is located at the end of this section on recommendations.

Consider the societal goals identified in table 1 in selecting variables.

Priority rankings for public interest previously identified in Table 1 as being supported by occupational classification are shown in table 11. These rankings are based on the assessment of the research team preparing this report as well as priorities expressed by respondents from whom information was obtained. The most important public interests are identified as: helping individuals with barriers to employment obtain jobs, helping displaced workers become reemployed, identifying essential competencies needed for employment, and making optimal matches between jobs and workers. This was followed in importance by: identifying career advancement opportunities for workers, helping students and workers make good career choices, providing current labor market information, making labor market projections, and integrating occupational data with other information about the work force. Following this in importance were public interests associated with historical, international and medical research.

Information elements currently used, and proposed for future use, in classifying occupations are rated according to their feasibility and shown in relationship to the public interests they support in table 11. There is significant variation in the number and combinations of information elements needed to support different public interests. A broad array of information is needed to help individuals overcome barriers to employment or to make good matches between job seekers and job openings. In comparison, relatively few information elements are needed to support research activities. All information elements provide support for more than one public interest, ranging from 2 interests supported by information about personal qualities required for jobs, to 8 interests supported by information identifying industries which use occupations, and 10 interests supported by making occupational information highly compatible with census and labor market data. The feasibility of providing information elements was ranked in three tiers: if it is already being (or could readily be) done in a satisfactory manner it was given a high feasibility rating, if methodologies appear available for generating the information it was given a medium feasibility rating, and the one case in which it appeared

infeasible to develop a satisfactory data gathering methodology (personal qualities required for occupations) was given a low feasibility rating.

By overlaying feasibility and priority rankings in table 12, four principal clusters of information elements are created. These clusters offer a possible set of priorities for the future SOC. Since there are not any information elements that support only threshold priority public interests (those elements supporting lower priorities such as research also support higher priorities such as helping displaced workers), and excluding the information element dealing with personal qualities needed for jobs because of infeasibility, all other information elements fall into one of the four possible combinations created by high and medium feasibility and high and medium priority.

The first cluster of occupational information elements that are both high priority and high feasibility should be the foundation of the future SOC. These include existing information elements identifying occupation specific skills and industries in which occupations are used, and new or revised information elements to identify educational requirements and necessary diplomas, licenses and certificates, as well as to enable linkage of occupational information with census and labor market data.

Most of the information elements in the second cluster that are medium priority but high feasibility (that is, can be done without great cost) are already part of the DOT. These should remain part of the new DOT/SOC and include: contextual information about work settings, extent to which occupations are subject to use as part time or temporary labor, requirements for physical capabilities and motor skills, and environmental conditions.

Table 11. Priority and feasibility of occupational elements

Types of occupational classification information	Feasibility	Priority of Public Interest Areas and Supporting Information Elements (Numbers match public interests listed in Table 1) Priority Ranking = Important, Very important, Most important											
		1 Over-come barriers	2 Dis-placed work-ers	3 Ad-vance-ment	4 Com-peten-cies	5 Career choices	6 Job matches	7 Current LMI	8 Job projec-tions	9 Inte-grate data	10 Histori-cal analy-sis	11 Inter-nation-al	12 Medi-cal re-search
A. Educational requirements	High	M	M	V		V	M					I	
B. Diplomas, licenses and certificates	High	M	M	V		V	M					I	
C. Competencies required by employers	Medium	M	M	V	M	V	M						
D. Occupation-specific skills and knowledge	High		M		M		M						
E. Generic/cross functional skill descriptors	Medium		M	V			M	V	V	V			
F. Generic descriptors for skill continuums	Medium			V			M	V	V	V			
G. Personal qualities required	Low	M			M								
H. Physical capabilities and motor skills	High	M	M		M	V	M						I
I. Aptitudes and interests	Medium	M	M			V	M						
J. Work activities, settings and interactions	High	M				V	M						
K. Degree of autonomy and work variation	Medium			V	M	V							
L. Use of part time or temporary labor	High			V		V							
M. Environmental conditions	High	M				V	M						I
N. Industries using occupations	High		M	V			M	V	V	V	I	I	I
O. Census of occupations by industry	Medium							V	V	V	I		
P. Link with census and labor market data	High	M	M	V		V		V		V	I	I	I

Table 12. Occupational information elements grouped by priority and feasibility

HIGH PRIORITY *high priority, threshold feasibility*	*high priority, medium feasibility*	*HIGH PRIORITY/FEASIBILITY* *high priority, high feasibility*
• Personal qualities needed for specific occupations.	• Crucial competencies needed to make applicants employer-acceptable in specific occupations. • Generic vocabulary for describing the same specific skill in different settings.	• Occupation-specific skills (e.g., types of machinery mastered, materials used, problem solving and analytic abilities, etc.). • Industries in which occupations are used. • Linkage of occupational information with other data. • Educational requirements for specific occupations. • Diplomas, licenses and certificates required for specific occupations.
medium priority, threshold feasibility	*medium priority, medium feasibility*	*medium priority, high feasibility*
	• Generic vocabulary for identifying skill continuums among different occupations. • Degree of autonomy and work variation in occupations. • Linkages between aptitudes, and interests, and the requirements of specific occupations. • Census of occupations by industry.	• Concrete information about what is experienced and done in specific occupations in terms of activities, work settings and interactions. • Extent to which occupations are intrinsic or extrinsic to industries. • Requirements of occupations in terms of physical capabilities and motor skills. • Environmental conditions associated with occupations.
threshold priority/ feasibility *THRESHOLD PRIORITY/FEASIBILITY*	*threshold priority, medium feasibility*	*threshold priority, high feasibility* *HIGH FEASIBILITY*

The third cluster of high priority, medium feasibility elements includes two types of skill related information that are the subject of much discussion and interest: identification of competencies required for specific occupations and developing a generic skill vocabulary that can be used to identify those same skills in different occupational settings. Inclusion of these information elements, particularly generic skill descriptions, is a major undertaking requiring significant funding to develop and carry out new information gathering methodologies. It is important to allocate the necessary resources because this information is essential for supporting critical public interests as well as for structuring the future DOT/SOC.

The fourth cluster includes four information elements that are important but also require development of new information gathering methodologies. These include: extending the capabilities of a generic skill vocabulary so as to enable identification of different skill levels within a common skill area, identifying the degree of autonomy and work variation in occupations, improving current capabilities for linking aptitudes and interests with occupations, and maintaining a census of occupations by industry. Each of these types of information supports important public interests in the work force. This information is needed for the future DOT/SOC but if a strategy of phased implementation is required, these information gathering efforts might be initiated after other efforts are underway.

The information elements identified in table 11 include many similarities to the variables listed in the APDOT Content Model, as discussed in table 13. However, while the APDOT Content Model includes a range of potential variables with differing levels of significance and feasibility, the information elements listed in table 11 are those we regard as most important and useful. As shown below, the first nine items of classification information listed in table 11 (labeled A to I) all take the form of Worker Attributes in the terminology of the APDOT Content Model. The next set (items labelled J,K, and L) refer to the Work Context and the Work Content and Outcomes. The final group of three (N, O, and P) refer to the Labor Market Context.

Occupational information elements (from table 11)	**APDOT content model items** (from table 13)
A. Education	11, 10
B. Diplomas etc.	8
C. Competencies	2
D. Occupations-specific skills/knowledge	4, 5
E. Generic skill descriptors	3, 21
F. Skill continuums	9
G. Personal qualities	6
H. Physical capacities, motor skills	18
I. Aptitudes and Interests	1, 7
J. Work activities, settings, etc.	13, 14, 19, 20, 22–24
K. Autonomy and work variation	16
L. Part-time or temporary labor	15
M. Environmental conditions	17
N. Industries using occupations	12

Occupational information elements (from table 11)	APDOT content model items (from table 13)
O. Census of occupations by industry	12
P. Link census and labor market data	25–29

• *Use sound theoretical principles in selecting variables and rating schemes, incorporating state-of-the-art cognitive science, psychometric testing and evaluation.*

The DOT variables were developed decades ago using available knowledge. Subsequently, the theoretical bases underlying some of the assumptions made in the DOT and similar rating systems have been tested and expanded, suggesting new ways of approaching the questions.

Technological change has meant that machines' repetitive tasks are increasingly mechanized, so that cognitive tasks (monitoring, recognizing and diagnosing problems, solving problems, and so on) become ever more important. However, DOT job descriptions emphasize behavior rather than cognitive activities that underlie observable activities. Different occupations require different kinds of cognitive abilities, with different levels of ability or skill. It has been suggested that the theory and methodology of cognitive task analysis (CTA) can provide insight into the variables to be measured, and the measures to use. However, present CTA methodologies involve in-depth and micro-level analyses of a single task, usually for training purposes or machine duplication. The methodological limitations and the high cost of analysis when done correctly using a trained analyst mean that CTA as such is not appropriate for occupational classification. However, Cooke (1992) notes that ". . . the goals of the DOT do not seem to merit an in-depth analysis of the facts and rules underlying each cognitive skill, but merely the knowledge that a specific cognitive skill is required for the job in question (p. 13)."

This suggests that the body of knowledge associated with CTA may be used to identify broad cognitive skills that can be used to distinguish one job from another, such as attention or complex reasoning.

• *Consider demands for customized aggregations when selecting SOC descriptor items.*

No single system of clustering occupations into job families will suit all purposes. If the information is provided in accessible databases, users will attempt to create their own hierarchies and clusters of job families based on selected descriptor items. The clusters that are likely to be most commonly demanded should be considered. These may include, for example, attempts to replicate past systems to produce time-series data; aggregations that match international systems; and aggregations on the basis of formal education and training.

Specific Problems in Defining and Measuring Central Variables

Skills

• *Ensure that information elements included in a SOC database meet the major needs of workers seeking placement. Incorporate a wide range of skills-related information, including indicators of cognitive requirements, complexity, responsibility, training requirements, and specific hiring criteria.*

Conceptions of Skill

The practical problem of deciding how to classify occupations leads to the difficult conceptual problems of defining and evaluating skills. There is no straightforward, widely-agreed upon definition of skill. Attewell (1989) identifies four paradigms that underlie different conceptions of skill:

> *Positivist:* Skill is "an attribute that is amenable to measurement . . . [that] has an objective quality independent of the observer" (p. 423); in practice, what is observed tends to be work tasks and behaviors, to which different levels of skill are ascribed; the highest-level skills are cognitive.
>
> *Anthropological:* "All human activity, even the most mundane, is quite complex" (p. 429); the most complex skills are those that have been internalized.
>
> *Neo-Weberian:* Skills are socially-constructed, and reflect the ability of professional organizations and unions to control entry into an occupation and career ladders; this is related to the social status afforded an occupation.
>
> *Marxian:* Skills are related to control over work; in capitalist societies, workers are progressively deskilled as managers design work processes that break down tasks into ever-simpler components.

Occupational skills are distinct from certification and educational qualifications for jobs. Many researchers using the DOT conflate these dimensions of work by using the General Educational Development (GED) and Specific Vocational Preparation (SVP) measures as proxies of occupational skills (as was done earlier in the case study of aerospace occupations). There is good reason for this, based on the assumption that time of training and education is correlated strongly with skill level. In reality the relationship between education and occupational skills is by no means straightforward. Holding a

bachelor's degree may be a necessary hiring requirement for many jobs, but the courses taken by undergraduates may have no connection with the occupational skills that are developed on the job. Time-based measures of skill level SVP and GED are inadequate indicators of the substantive skills of an occupation, and which skills are transferable. The SOC system should reflect the barriers to employment and job mobility that are enforced by educational requirements and other institutional controls over labor supply and hiring patterns, including professional certification and union membership. The specific educational and training requirements of occupations should be included in the SOC to inform workers of typical hiring criteria and job ladders in different occupations.

• *Review the measurements of skill and consider the relationship between actual and objective skill requirements.*

In the current DOT, the measures of SVP and GED are presented as independent and relatively objective indicators of the real skill requirements of the occupation. However, there are several problems that arise with their use.

1. GED measures refer to the knowledge and skills taught in school, but do not explicitly relate GED scores to any level of formal education. Non-DOT sources have developed equivalencies which translate GED levels into years of formal education, but these are not easily accessible to average users. There is a need for formal educational requirements to be spelled out to make the entry requirements for jobs more understandable for users.
2. There is a difference between the *objective* requirements of an occupation in terms of reading, mathematical and reasoning skills, and the *actual* demands of employers for educational certification. In other words, a certain job may be performed acceptably by a worker with no more than an eighth grade education, but in the real-world operation of the labor market, no applicant with less than a high school diploma is recruited or hired for that job. This issue is sharply revealed by comparing GED ratings for occupations with workforce education levels. The actual knowledge of the workforce, as measured by educational attainment, appears to largely exceed the knowledge requirements of jobs as measured by the GED. One analysis (Law, 1992) found that 48 percent of the jobs in the USA in 1984 require a GED of 1 to 3, roughly equivalent to an eighth grade education or less. However, only 8 percent of the employed population had eight years or less of schooling, indicating underuse of qualified job applicants.

   While it may be useful to researchers to trace changes in the objective knowledge requirements of occupations, workers need realistic information on the entry requirements for different occupations. In addition, it is doubtful whether job analysts can consistently identify cases where objective knowledge requirements diverge from the actual requirements. For these reasons, a measure of actual knowledge requirements, where these are consistently applied across an occupation, might be more useful and reliable than an attempted objective measure.
3. A simple analysis of the relationship between SVP rating and field of work suggests that SVP ratings have not been objectively and consistently applied across DOT divisions. Higher ratings (SVP=8) are applied to certain skilled and supervisory occupations in some divisions (such as processing and structural fields) but lower ratings (SVP=7) are assigned to occupations in service divisions despite seemingly similar training requirements. This apparently systematic downgrading of certain fields of work, which is not apparent to the average user who assumes general consistency, calls into question the methodology of assigning SVP.

• *Include measures of occupation-specific and transferable skills in the sorting variables for the DOT and the SOC. Ensure that the SOC basic occupational units contain information elements that facilitate skill transferability.*

The issue of skill transferability is a central focus of concern in current research and debate on the occupational classification system. Ideally, each occupation should be described in terms of a combination of occupation-specific and transferable skills. The occupations sharing the same transferable skills represent potential avenues for mobility. This method would allow users to locate alternative occupations that are removed from the typical career ladders or groupings of related jobs based on similarity of work performed. The current DOT set of worker functions (relationship to data, people, things) offers a simple version of non-specific skills.

Some of the research into cognitive activities has generated promising seeds for the eventual development of a theoretically rooted scheme of cognitive activities reflecting transferable skills. Drewes' (1993), suggestions that the world of work can be partitioned into task domains, defined as *a set or grouping of similar work situations*, sharing closely related objects, properties, operational procedures, and methodologies (this is similar to an occupation). He suggests that a list of about 25 to 50 core cognitive processes could be developed, along

with a taxonomy of work fields (revising the current DOT listing) to define those that share a common "device model." The work fields would be characterized by the materials, tools, processes, and outcomes. Each occupation (SOC unit group) would be identified with a single work field. Core cognitive processes would be described using verbs appropriate to the work process in each work field. These phrases or Generalized Work Activities (GWA) would consist of a process-oriented verb (one manifestation of a core cognitive process) and a label (an object and/or process). It would be "a cognitively oriented activity statement tailor-made for a specific SOC occupation" (Drewes, 1993, p. 29). Each SOC would have multiple GWA's, including both occupationally specific GWA's and SOC-general GWA's identified from current job analysis instruments such as the Position Analysis Questionnaire (PAQ).

The GWA's would be SOC occupational descriptors, equivalent to the task and duty statements in the current DOT, and would "function as linkage mediators in the determination of SOC occupational ability requirements" (Drewes 1993, p. 31). They could be used to operationalize the concept of skill transferability so that skills could be transferred across occupations that share common underlying cognitive requirements, and share overlapping substantive knowledge requirements.

Harvey (1992) also suggests a similar concept (Generalized Work Behaviors) of "moderate behavioral specificity, measured using a rating scale metric that is cross-job-relative and which allows meaningful level-based comparisons to be made between occupations" (p. 12). There is a strong conceptual advantage to developing a common profile of all GWB's and a single GWB-rating instrument. It would also be the most cost-effective method.

Although the concept of a generalizable measure of transferable skills is appealing, there are many problems in operationalizing it. As Drewes (1993) notes, the cognitive processes identified in the current literature are similar to the Relationship to Data element in the Worker Functions of the present DOT. But the cognitive processes discussed do not include any that might apply to the social interaction and communications activities associated with the People worker function. Drewes describes the Things function as a motor processing control activity rather than a cognitive process, and it too is excluded. Since social and physical/motor skills make up such a significant component of so many occupations, the existing DOT worker functions should not be abandoned until a fully adequate alternative is available to take their place. The GWA's, as presently described, can only deal with one component of transferable skills.

Authority. Much more research is needed into the various components of authority, responsibility, and autonomy. For example, we can distinguish between responsibility for human life (such as a child-care worker) and for valuable property (such as a machinist). As work is reorganized, some of the historically autonomous work fields (such as clerical work) are becoming subject to greater scrutiny and control (through, for example, keystroke monitoring), while historically structured work is in some cases becoming more autonomous (for example, team concept assembly).

Although the DOT does not explicitly use supervisory authority as an organizing principle, a closer examination reveals many instances where such decisions have been made. At the most obvious, the category of professional and executive occupations reflects a classification decision that distinguishes top-level executives from lower level supervisors. The SOC does explicitly separate out occupations on the basis of authority. The current SOC is based on the principle that "Supervisors should be identified separately from the workers they supervise wherever possible in keeping with the real structure of the world of work." (Michigan OAFC, 1992: 7). The SOC places all supervisors in an exclusive major group preceding the major groups containing the supervised positions. A similar problem emerges with respect to helpers. They are grouped with the occupations they are helping in the DOT, but grouped separately in the SOC.

Work fields. Work fields are based on the type of work performed. Specifically, work fields can be distinguished by the technology and equipment used by workers, the object of the work (for example, making a product, providing a service), and the specialized knowledge required for work. This is the least problematic dimension by which occupations are classified, since we are dealing with readily-recognized relations between workers, what they work with, and the end result of their work. The more difficult questions revolve around the skills employed in the work process and issues of worker authority.

Work fields should not be confused with industry, although the industry context in many cases defines the work field. This is especially the case for specialized manufacturing occupations. For example, the work field of an aerospace machinist is most strongly identified with the technology used and the product being made. However, the work field of many occupations is best identified with the function performed and the technology used, rather than the outcome of the production process. Clerical and sales workers, for example, are found in every industry.

Recommendations on uses

• *Core recommendation three. Simplify the connection between occupational, labor market, social, and demographic information by using the revised SOC unit group as the main occupational group.*

A potential strength of the SOC is its use in connecting the wealth of occupational information collected by job analysis with the employment statistics and demographic information collected through surveys and the Census. An uncomplicated and widely accepted occupational classification which simplifies and aids the connection among these data sources will have a synergistic effect in increasing the power of the information.

Workers today face upheaval and dislocation as the economy restructures, and the prospect that technical obsolescence may destroy their job. Moreover, institutions to support and guide them as they change jobs (internal job ladders, unions, and stable social networks) are no longer widely available. The need for high-quality occupational and labor market information is critical for workers forced to change jobs and possibly careers.

• *Collect occupational and labor market information using the same occupational classification system. Coordinate the occupational structure used in the OES and US Census of Industries and Occupations to generate a single set of occupations, obviating the need for crosswalks.*

The SOC should be the primary occupational classification system. There should be no need for crosswalks (that is, there should be one standard occupational classification system, not two or three or more). Occupational information should not be collected for one occupational classification level (for example, DOT) while labor market information is collected for another (for example, the SOC); it is very important to link occupational and labor market information directly through the same occupation groups.

The excessive disaggregation of DOT occupations all but prevents their use in collecting labor market information. The OES and SOC groups are much more practical to use for this purpose, because of cost feasibility and data reliability. Since most labor market information is collected by occupation at the OES level rather than the DOT level, there is no direct way to determine labor market trends and characteristics for DOT occupations (an exception to this generalization is state-level occupational guides which are sometimes done for specific DOT's). Although the DOT titles within each OES group are known, the occupational information connected with each DOT title cannot be linked directly with the information collected for the OES group. The DOT now allows great flexibility in grouping occupations on the basis of user-defined criteria; the future SOC/DOT should also enable linkages with labor market information to provide information, for example, about which occupations are the fastest growing, employ the most workers, or pay the highest wages in the community or region.

• *Contribute to public policy through research using occupational information that is reliable, comprehensive, consistent, clearly defined, and comparable with other data sources.*

Research that contributes to public policy draws on occupational information. To meet the needs of reliable research, the SOC/DOT occupational classification system should be:

Comprehensive, the coverage should include all occupations;

Reliable, the data should be based on reliable methodology;

Consistent, categories must be internally consistent, and there must be consistency to some extent in the aggregation;

Clearly defined, the meaning of categories and information elements must be clear; and

Comparable with other data sources, the most important aspect is probably comparability with social and demographic information in the U.S. Census, but comparability with information from other countries is also valuable.

• *Incorporate recent developments in geographic information collection, management, and analysis in the form of GIS.*

Geographic Information System (GIS) is the generic name for a computer system which integrates statistical and spatial analysis. It covers the computer software, databases, and hardware that allow spatial information to be organized, manipulated, analyzed and mapped. GIS is more powerful than related computer functions such as computer-aided design (CAD), since it has the potential to inter-relate and analyze data in *both* spatial and numerical form. The data input can be in numerical or graphic format, and the output can be generated as printout, maps or other graphic displays. Typically, a GIS will be able to deal with large data sets including many different characteristics relating to a common spatial area, and present the results in a range of cartographic alternatives. The activities made possible by a GIS include map digitizing, data transfer, relational database management, map overlay display, interactive graphics editing, address geocoding, and network analysis.

The central elements used in a GIS operation are the spatial information or *coverages*, and the attribute tables, or *database*. The two are connected by a variable that links a numerical code (such as the number of a census tract) with a digitally defined map feature (such as the tract area) in a coverage (a map which has been digitalized and stored in the computer memory). Coverages commonly use spatial zones such as census tracts, zip

code areas, city, county, State, and National boundaries. Many digitalized coverages may be purchased, and users may create individualized coverages by clustering zones or using overlays. Coverages can also be prepared by digitalizing (using a digitizer) from existing maps to define features such as points, lines, and areas to which data can be linked. The database will typically include a range of variables associated with geographic features. For example, census data is available for each census tract. Relational database management software (such as dBase) can be used to store and manipulate the data.

• *Use existing sources of labor market information in geographic analysis.*

There are at least two existing sources of labor market information with a spatial component which could usefully be related and analyzed by a GIS. The first is information on existing and potential *workers, by place of residence or place of work;* the second is information on *jobs, by site of work.* Sources such as the U.S. Census of Population provide tabulations at the census-tract level on residential population characteristics such as education, employment status, etc. Some tabulations on worker population characteristics such as wages and broad occupation are also available at a fine level (one or two census tracts) in data files from the Census Bureau. The Public Use Microdata Sample (PUMS) of the Population Census provides a sample of individual cases for independent tabulation for large spatial areas (metropolitan region or larger). Local agencies (such as employment services, unemployment offices) that collect data on workers or job-seekers can organize their data by spatial unit such as residence in zip code area.

Information on jobs at a fine geographic scale (for example, zip code) is also available, although confidentiality concerns often restrict the collection and publication of this data. More commonly, information is presented in larger spatial units such as the county or city. Useful sources of job information include the OES and the labor market surveys conducted by state public employment services. Since digitized coverages already exist of census tracts (U.S. Bureau of Census GBF/DIME and TIGER/Line files), postal zip codes, and most city and county boundaries, it would be relatively easy to organize and link job and worker information using the common spatial variables they share. Employment-by-establishment data are also collected and integrated geographically by connecting Unemployment Insurance data by firm with DIME-type files and allocating employment to actual census tracts.

A spatial analysis of labor market information would be of interest to individual job-seekers (who need to identify where the jobs are as well as identifying an individual job), as well as of some utility for employers, and would be especially useful for public policy and planning. For example, commuting may be reduced if firms use more precise information about the residential location of their desired labor pool in making siting decisions, and job training services could be located at maximum benefit in the areas that are identified as having the greatest need.

Since the collection and release of labor market and population information are often subject to concerns about privacy, it is likely that level of detail in occupational information will be related to the geographical scale. At finer spatial scales, less detailed information will be available on the whole population; where detailed information is given, it will typically be for a self-selected sample such as workseekers. So, for example, at the census tract level we can expect to use very broad occupational categories. Some examples of the kinds of questions that may be addressed by a GIS analysis using a fine geographic scale and broadly-defined labor market information are given below, using data that is either already available or could easily be collected.

• Where do the most highly educated members of the city's labor force live?

(Use census information on the percentage of adults with a college education in the residential population of each census tract; display in map form.)

• How many self-employed individuals live within 10 miles of a certain site?

(Use the variable "self-employed" in census data; identify each census tract within 10 miles of given census tract; sum the total.)

• What parts of the city have a high residential population of young high school graduates and a low share of entry-level positions?

(Generate a map by census tract of the share of young high school graduates using education and age variables; generate a map by zip code of entry level job opening based on an application of a given occupational structure to the known industrial composition of each zip code; overlay maps and identify areas of high concentration in each.)

At a larger geographic scale, more detailed occupational information could be brought to bear, as shown in the sample questions below.

• Where in the USA are registered nurses most highly concentrated?

(Generate a map of all counties in the United States showing the percentage of a given occupation (registered nurse) in the local workforce.)

• Which counties show the greatest disparity between the estimated number of jobs as bank tellers and the number of workers with experience or training in that occupation?

(Generate scores for each variable for each county; map the distribution of the resultant variable)

• Which states show a mismatch between the years of schooling attained by adults entering the labor market, and the schooling required by local employers? Which states show evidence of a mismatch in the future, given trends in industrial growth and in schooling?

• *Make full use of opportunities for linking occupational information from a number of sources.*

GIS is a potentially valuable tool in labor market analysis, and may be used in a variety of ways to improve understanding and presentation of information. However, the power of analysis depends to a great degree on the ability to inter-relate different sources of data through their shared spatial component. If the occupational classification system (DOT/SOC) is to be useful in future GIS applications, it is essential that the opportunities for linking occupational information from a number of sources be maximized. The following three recommendations discuss some guidelines that will help achieve this end.

• *Ensure that occupational classifications used in the worker-based information sources (such as population census) match (as much as possible) the job-based sources (such as data from firms).*

Both the basic unit occupational definitions, and the aggregations of occupations into job families should match where possible.

• *Design aggregation of occupations into broad clusters (which will be relied upon where occupational data must be aggregated to protect confidentiality in fine geographic scales) to meet the needs of all users.*

It is important to design the future SOC/DOT classification structure to achieve maximum homogeneity of critical variables at all levels of aggregation. In restructuring the DOT/SOC consideration should be given to providing the basis for alternative groupings if a single hierarchy is insufficient. This will ensure that census and labor market data can usefully be merged with key occupational variables, even if the data must be highly aggregated because of confidentiality considerations.

• *Consider current sources of worker or job data with spatial information as potential components of a future labor market database forming part of a GIS analysis.*

For example, information collected through unemployment insurance contributions, Social Security payments, post-secondary education and certification, immigrant work permits, and so on may all be coded with spatial information and used in analysis.

• *Integrate wage and claims data showing earnings and employment histories of workers with job service occupational coding data showing the classification codes for previous and placement occupations of individuals receiving public employment services.*

Policy-relevant issues about which this will provide information include the following:

• Career transition paths,
• Outcomes for displaced workers,
• Job stability in specific occupations,
• Earnings patterns in specific occupations,
• Worker attributes associated with obtaining employment in specific occupations,
• Worker attributes associated with retaining employment in specific occupations,
• Worker attributes associated with upward mobility,
• Demographic characteristics of workers in specific occupations, and
• Occupational distribution of unemployed workers and ratios of employed to unemployed workers in each occupation.

• *Integrate occupational matrices, jobs listed with the public employment service and ES-202 data.*

This will provide information about:

• Occupations in which job creation is occurring,
• Critical skill shortages which constrain industry growth,
• Changes in occupational composition of specific industries, and
• Interrelationships between changes in occupational structure and changes in industry employment levels and skill requirements.

Summary

The purpose of creating a new SOC should be to help workers obtain jobs and quality career counseling, and to improve the quality and application of research on occupational and labor market structures and trends. To meet these goals, the classification of occupations in the SOC should be based on a combination of skill levels, authority, and work fields. The DOT and SOC should be integrated into a single occupational classification system, using the SOC as the primary group, and DOT-type occupations as unit groups, with both levels containing detailed occupational information to facilitate

job placement and research. This will result in an integrated classification system with significantly fewer occupations than the current DOT. The DOT is impractical to use for job placement, as it is difficult to find worker-job matches on the basis of DOT titles, and the information elements included in the DOT titles are not designed to match occupations in different industries on the basis of skills transferability and hiring criteria. Moreover, labor market and social information is usually collected for SOC or OES occupation groups which are aggregates of DOT titles, but do not contain occupational information elements. The ability to link occupational and labor market information at different geographical levels is especially important to support workers, employers, job service officials, and policy makers in building high-wage, high-skill jobs in an evolving economy.

Table 13. Evaluation of variables in content model proposed in APDOT final report

Name of Variable	Comments
Worker attributes	• Distinguish between (a) those attributes or skills required by employers, and (b) those attributes or skills that are possessed by the individual (see Wootten 1993: p.9).
1. Aptitudes and abilities	• Individual attribute. • Not appropriate as a sorting variable; may be included as supplementary. • Not feasible to collect during job analysis. Some information may be gathered from results of validity testing of aptitude tests such as GATB. • Low priority in allocation of funds.
2. Workplace basic skills	• Achievement attribute. • Not useful as sorting variables to distinguish among occupations, since refers to fundamental abilities required to a certain extent in almost all jobs. May be useful to identify jobs with very low educational requirements; helpful in placing workers with developmental disabilities. Survey of DOT users (Westat, 1993) revealed support for inclusion. Specification of the minimum requirements for a range of entry-level jobs may be an important contribution to educational reform, as promoted by SCANS. • Feasible to collect during job analysis. Measure by GED or by 'competencies' identified by SCANS.
3. Cross-functional skills	• Achievement attribute. • Not appropriate as sorting variable. • Useful in determining skill transferability and mobility prospects. • Feasible to collect during job analysis. More research needed into ways of specifying skills. Some potential in Generalized Work Activities.
4. Occupation-specific skills	• Achievement attribute. • Useful as a sorting variable for fine distinctions among similar occupations. • Useful information for job-seekers. • Feasible to collect during job analysis.
5. Occupation-specific knowledge	• Achievement attribute. • Useful as a sorting variable for fine distinctions among similar occupations. • Useful information for job-seekers. • Feasible to collect during job analysis. Distinction between #4 and #5 is not always clear.
6. Personal qualities	• Individual attribute. • Not appropriate as a sorting variable; may be included as supplementary information. • Not feasible nor appropriate to collect during job analysis; issues of intrusiveness and validity arise. Some information may be gathered from results of validity testing of aptitude tests such as GATB. • Low priority in allocation of funds.
7. Interests	• Individual attribute. • Not appropriate as a sorting variable; may be included as supplementary information. • Not feasible or appropriate to collect during job analysis. Some information may be gathered from results of validity testing of aptitude tests such as GATB. • Low priority in allocation of funds.
8. Licensure/certification	• Achievement attribute. • Useful sorting variable for professional and skilled technical occupations. May be useful as a sorting variable to make fine distinctions among related lower-skill occupations. • Essential information for users in job matching and vocational counseling. • Feasible to collect during job analysis.
9. Work experience	• Achievement attribute. • Distinguish between (a) amount of work experience in specified fields/occupations required to qualify for an occupation; and (b) average years of work experience in present occupation by workers. • Required work experience, when combined with training time and education, is a useful sorting variable of broad skill level. • Detail on specific required work experience for individual occupations is appropriate as a supplementary variable. This information is useful for workers to indicate career ladders. Data on average years of work experience by job-holders is useful indicator of career paths. • Feasible to collect required work experience during job analysis, including surveys. • Feasible to collect information on average years of work experience from Census.
10. Formal education	• Achievement attribute. • Distinguish between (a) formal educational requirements for occupation and (b) average education achieved by workers in an occupation.

Table 13. Evaluation of variables in content model proposed in APDOT final report—Continued

Name of Variable	Comments
	• Essential information for workers. If labor market practices involve requiring lower or higher educational levels than objectively defined for the occupation, this should be recorded. • Required education is useful as a sorting variable. Actual average education may be included as a supplementary variable. • Feasible to collect information on formal requirements in job analysis, including surveys. Reconsider use of GED as measure; maybe supplement with a measure directly related to standard educational levels (for example, high school diploma). • Feasible to collect data on actual educational achievements by occupation from Census.
11. Formal training	• Achievement attribute. • Useful as a sorting variable. • Feasible to collect during job analysis, including surveys. • Current measure of SVP (in months and years of training time) is appropriate, and should not be altered to indicate hours of required training (reported in Westat 1993) without widespread consensus. • SVP rating measure should be more consistently applied than in the current DOT (see appendix). These variables should complement, but not be used as a substitute for, the skill-related variables #2-#5, as well as #8.
Other	• Skill measures should be re-evaluated and revised. The skill measures used as sorting variables for the DOT and the SOC may contain different levels of detail. • The range of skill measures should include a common measure of broad skill such as years of schooling or college.
Work context	
12. Industry	• Make a distinction between *work field* and *industry*. Work field is defined by the materials, activities, products, and processes, and in some cases is closely related to industry, but not always. It may be used as a sorting variable. • Industry refers to the industries in which a particular occupation is to be found, indicated by SIC category. Some occupations found in all industries. • Useful for workseekers. • Work field useful as a major sorting variable; industry useful for fine distinctions. • Feasible to collect information on work field and some information on industry during job analysis, including surveys. • Feasible to collect specific information on numbers, proportion of occupations by industry from OES and Census. Data on distribution of occupations by industry should be part of regularly updated database associated with DOT/SOC system.
13. Organizational structure	• Not appropriate as a sorting variable. • May be useful as supplementary variable; needs more research into content and rating methods. • Low priority for funds.
14. Organizational culture	• Not appropriate as a sorting variable. • May be useful as supplementary variable; needs more research into content and rating methods. • Low priority for funds.
15. Terms and conditions	• Not appropriate as a sorting variable. • Useful information for workers. • Useful as a supplementary variable. Measures should incorporate all recent developments in contingent labor practices, such as commission, part-time, internship, contract, on-call arrangements, home-work, etc.
16. Work system/job design	• Supervisory authority is an essential sorting variable. Related aspects such as responsibility for life or property, and degree of autonomy and control over work should also be addressed. • Other aspects are not useful as sorting variables. Need more research and consensus on importance before resources are allocated to include them in database as supplementary variables. Consider incorporating a measure of non-physical aspects of working conditions to supplement #17. To include, for example, high-stress emotional/social demands, such as caring for dying people. • Feasible to collect information on supervisory authority during job analysis. New measures of management functions should be developed. Draw on Relationship to People worker function in existing DOT.
17. Physical working conditions	• Useful as sorting variable in highly simplified form: e.g. occupation does or does not involve significant exposure to unpleasant and hazardous conditions. • More detailed information can be included as supplementary variables. • Feasible to collect data during job analysis. • Some items (such as exposure to cold) are seldom used, and may be dropped. Items rated should be changed to reflect new conditions at work: e.g. greater attention to exposure to hazardous chemicals, dangerous work processes inducing repetitive stress syndromes, emotional stress-related conditions.
18. Physical, sensory, perceptual and cognitive demands	• Useful as a sorting variable. • The existing DOT data is an essential resource for placement for people with disabilities. Useful in conjunction with skill data to identify job mobility options. • Feasible to collect during job analysis. Use cognitive task analysis to identify central cognitive demands, for example attentiveness.
19. Machines, tools and equipment used	• Useful as a sorting variable, especially for manufacturing jobs. • Useful information for workers as part of identifying transferable skills. • Feasible to collect during job analysis.
20. Performance standards	• Not useful as a sorting variable. • Low importance for workers.

Table 13. Evaluation of variables in content model proposed in APDOT final report—Continued

Name of Variable	Comments
	• Needs wider consensus on importance and rating measures before resources are allocated to information collection. • Low priority for funding.
Work content and outcomes	• Together with skills-related variables and work authority, these variables are important sorting variables, defining distinct work specializations.
21. Generalized work activities	• Useful as sorting variable. • Should be related to measures of cross-functional skills. • Feasible to collect during job analysis. Some problems in defining tasks at appropriate level of specificity.
22. Duties/ tasks performed	• Useful as sorting variable. • Feasible to collect during job analysis.
23. Services rendered	• Useful as sorting variable. • Feasible to collect during job analysis.
24. Products produced	• Useful as sorting variable. • Feasible to collect during job analysis.
Labor market context	• None of these variables are appropriate for use as sorting variables, except used to check that occupations defined are viable size. However, most are essential components of a regularly updated database linked to the occupational classification system.
25. Occupational outlook	• Essential part of regularly updated database associated with DOT/SOC. • Feasible to collect through OES and related surveys.
26. Labor market trends	• Essential part of regularly updated database associated with DOT/SOC. • Feasible to collect through OES and related surveys.
27. Economic trends	• Essential part of regularly updated database associated with DOT/SOC. • Feasible to collect through existing surveys.
28. Nature of job changes	• Useful part of database. • Feasible to collect through industry surveys organized by occupation.
29. Location of jobs	• Refer to geographic location of occupations. Location of occupations within organization is more appropriately included under work system/job design. • Geographic information on distribution of occupations is useful to job-seekers. • Feasible to collect local labor market data from OES surveys.

Implementation

The quality of the new SOC system depends upon comprehensive, scientific data collection and analysis, constant maintenance and revision, and widespread dissemination and use. Each of these goals should be followed to justify the time and effort involved in restructuring the SOC. No matter how rigorous and conceptually-sound the classifications principles, choice of variables, and system structure, the quality of the system depends upon the data collection methodology, which should be based on sectorally- and geographically-representative samples of establishments. The system must be regularly maintained and updated in order to be of value to users, who need up-to-date information on occupations and labor market conditions. Last but not least, the SOC should be widely publicized and distributed. The widespread use of the SOC will provide the added benefit of building broad public support for maintaining and revising a high-quality system.

Data collection

• *Collect occupational information through a combination of surveys, interviews, job observation, and research.*

Written surveys should be the primary method of collecting occupational information for the new DOT/SOC. The surveys should be comprehensive, and ask for detailed information about job content and context. Surveys should be sent to a sample of establishments which is sectorally and geographically representative. This accords with recommendations made by the APDOT Interim Report and other consultants providing feedback on revising the DOT/SOC.

Surveys should not be relied on completely, however. Interviews and on-site job evaluations should be conducted in order to flesh out the quality of occupational information, and to obtain information which may not be covered sufficiently by surveys, including how one job fits into a production process, the organizational context of work, and assessments of skill which require direct observation and worker interviews.

If the new DOT/SOC is implemented and used as the sole occupational classification system, this will contribute to the stock of occupational information through data collection and research by academics, government research departments at all levels, employers, unions, and other existing and new users of the DOT/SOC. Databases can be generated through official information gathering channels, for example, through Unemployment Insurance records, Employment Service offices, and other systems which record personal information. Information gathered in this way, outside the Department of Labor's occupational data collection projects, should be used regularly to maintain and revise the occupational database.

• *Design a sampling methodology for the new SOC that corrects the sampling biases of the DOT. Base the sample*

design on the sectoral and geographical distribution of industries and occupations.

The DOT is top-heavy with manufacturing titles, which comprise 67 percent of all DOT titles. Five manufacturing specializations together account for almost 1 in 4 DOT titles (2,928). This is a consequence of basing the classification system on tasks, and the dominance of mass production manufacturing industries when the DOT was developed in the 1930's and 1940's. Job analyses for the DOT reflected the fragmentation of tasks in manufacturing corporations, down to the precise machinery and equipment used, materials worked with, and operations performed on different materials, components, and products. Revisions of the DOT, including the fourth edition, used the previous DOT as a sampling frame, reproducing the manufacturing bias of DOT and giving insufficient attention to the changing occupational structure, in which non-manufacturing occupations now employ 3 in 4 workers.

The distribution of DOT titles is biased towards low-skill occupations (See tables 16-19 in the Appendix). Forty-two percent of DOT titles (5,333) are low-skill occupations with an SVP of 3 or less (requiring no more than 3 months of vocational preparation). It is difficult to justify covering low-skill jobs in such detail, particularly in manufacturing, where jobs are evolving through processes of organizational and labor market restructuring. Such detailed coverage of low-skill manufacturing occupations serves little purpose for worker-job matching or career counseling, which should be oriented towards skills development and transfer.

To confront these problems, the SOC should be based on scientific samples which cover the diversity of occupational specializations without overemphasizing one sector. Part of the problem will be resolved by using a classification system based on skill levels and work fields, which should aggregate numerous occupations which are distinguished in the current system by idiosyncratic tasks (for example, on this basis the 70-odd sewing machine operating and tending occupations could be reduced to one, or a few, SOC groups). In the service industries, special attention needs to be given to the explosion of occupations related to information technology and health care, among other services. (The Fourth Edition of the DOT includes only 21 DOT titles in the Computer Related Occupations division, compared to 844 DOT titles in the Food and Tobacco Processing Occupations division.)

In addition, the sampling design should be geographically-based. According to the NRC report, job analyses were assigned to Occupational Analysis Field Centers on the basis of proximity to industries; as one staffer reported, it "made sense" to assign wood furniture and textiles to the North Carolina office. This leads to a problem of geographical bias: the erroneous assumption is made that there are no significant regional differences in an industry's jobs. For example, DOT titles in the wood furniture industry are based on job analyses in North Carolina furniture factories. This seems logical, since North Carolina is the major furniture producing region in the United States. However, furniture jobs in North Carolina may not be the same as furniture jobs in Los Angeles, another major furniture producing center. Industry-based job analyses should be based on geographical samples to balance regional distinctions in job structures. This problem is accentuated with the highly-detailed DOT: some occupations may be found in workplaces in one region but not in other; whereas a broader definition could describe the key skill-based components of an occupation, without defining highly specific tasks.

• *Collect "local" labor market information for worker-job matching and occupational and labor market research.*

Most job searches are local. Income constraints, lack of information about job openings in other places, and social ties inhibit geographical worker mobility. Geographically-coded labor market information would allow workers, researchers, and other users to determine the best potential local or regional mobility paths on the basis of occupational employment levels, growth or decline, wages, and other relevant information. In cases where workers are willing to move in search of jobs, they could also obtain information on potential job paths in numerous other labor markets. In which localities is employment in a worker's occupation and related occupations greatest? Where is it growing fastest? Where can they get the highest wages relative to the local cost of living? Information on skills, tasks, and other occupational characteristics should be used together with labor market information, including occupational employment trends, wages, turnover, demographic composition, hiring criteria.

• *Coordinate efforts by national, state, regional, and local agencies to collect and disseminate labor market information.*

Data-gathering, processing, and publication should be coordinated so that efforts of different agencies are streamlined and mutually-reinforcing. Agencies should share information and learn from each other on a regular basis. Information gathered in Los Angeles should be compatible with information gathered in New York or Boise. Local and regional labor market reports and occupational outlooks should be published on a consistent basis.

• *Use census data on employment levels by occupation to select redundant and obsolete DOT titles for elimination.*

Useable occupational data has been collected through inclusion of occupational information questions in the censuses of population and housing in Australia, Japan, and Great Britain. This suggests that it is possible to collect occupational data for inclusion in a dictionary-type system from census data. While reference has been made to problems of accuracy in self-assessment data, good statistical procedures, careful and knowledgeable editing by well-trained staff, a continuing sample (such as the Current Population Survey conducted by the University of Michigan), and a computer-aided editing and coding system could provide a valid base for determining proportionate amounts of the individual occupations included in each SOC cluster. These figures, made available for the first time, would provide in turn a base for elimination of those titles too insignificant to be included in the DOT. These data would also permit a reconciliation of supply and demand since data could be made available on the occupations held by both the employed and the unemployed. Such data could also be obtained on a geographical basis, by gender, age, ethnicity, and other social characteristics.

• *Reduce the number of DOT titles by performing a computerized analysis of DOT occupational descriptions and ratings to identify titles to be merged.*

Comparisons by like, exact, or parallel key words referring to tasks, object of work performed, materials used, skills needed, industrial attachment, machines involved, and other aspects of job definitions could be made through a computer program designed to find such similarities, somewhat in the order of the job match programs now in use in some employment service offices. The compared and matched definitions could be analyzed for major discrepancies, and the resultant like ones rolled into a merged occupation. Differences, if significant, could be noted in the definition.

Most Common Kinds of Users and Fields of Use for DOT/SOC

State Employment Service Offices.
Schools (at all levels, and both private and public).
Private for-profit businesses (personnel departments, human resources departments, wage and hour departments).
Non-profit departments (primarily dealing with vocational and career counseling).
Libraries (public and research-related; school).
Social Security Offices.
Law Offices (especially those dealing with immigration law and labor certification).
Physicians (especially those who act as expert witnesses in cases of injury and accident).
Unemployment Rehabilitations Agency staff.
Unions.
Bureau of Apprenticeship Standards Field Offices.
Vocational and Technical Schools.
Work-training and Work-fare Organizations.
Teachers/researchers (especially in sociology, economics, psychology).
Veterans Administration.
State Unemployment and Disability Offices.

Investigation could be made of entries with the same titles differentiated only by Roman numerals, and each with a different code number. Examples include Milling Machine Set-Up Operator I and Milling Machine Set-Up Operator II. Another area of investigation would include occupations with the exact titles, differentiated only by industry or materials on which work is performed. Analysis of work performed in some instances shows great similarity. Amalgamation or "collapsing" of some similar tasks or of assembly-line operations could reduce the number of individual occupational titles and codes without losing necessary information for training, recruitment, or referral purposes. A worker capable of performing one of the connected assembly-line operations could be transferred to other closely related activities with little additional training or problems of adaption.

Most Common Uses for DOT/SOC Information

Career and Vocational Counseling.
Library reference.
Vocational rehabilitation counseling and determinations of work/job potential by disability constraints.
Job Development.
Job Placement, including selection, recruitment and referral.
Personnel management operations, particularly in the areas of recruitment, selection, wage determinations, ratings, and promotions.
Curriculum development and training programs content.
Vocational Choice assistance.
Labor market Information reports.
Apprenticeship programs.
Unions: job descriptions, wage determinations.
Social, economic and psychological research.
Foreign labor certification.
Labor force projections: employment by industry and occupation.

Developing a database

• *Emphasize the potential (or "should-be") user of the DOT/SOC system as well as those who are actual or typical users.*

Surveys on the uses of the DOT have tended to focus on existing users, determined by obtaining a list of buyers of the publication. Users are frequently mandated by law or rules to apply the DOT/SOC data and design to their data compilations and their work assignments. The focus on the 'already converted' may be misplaced. One occupational expert has noted that users "often can't tell you what they want or need—they rely on advice from others . . . . An alleged need for occupational information is also a function of who is expected to pay for the information" (Stevens, 1991: 2-3). The accompanying text boxes present a partial list of the most common users and uses of the DOT/SOC system.

• *Design a data base that is comprehensive and accessible.*

In order to provide the information and statistics needed by current and prospective users, it will be necessary to design, construct and maintain a data base and an accessibility system which will include prepared menus enabling the average users to extract, manipulate, and format the data as needed. The output should be of benefit and interest to a wide variety of users, including those who assist workers and job-seekers as well as researchers.

The list of materials which should make up the occupational information data base should be considered open-ended, with new subjects added when determined as essential, useful and acceptable, and with existing subjects eliminated when obsolete. While some users will not have ready access to the computer facilities to make full use of the database, it is essential that computerization of the information be given a high priority and be fully funded. The items suggested for inclusion on the data base are listed in Table 14.

System maintenance and support institutions

• *Update and revise the SOC on a regular basis, in order to maintain its currency and usefulness to workers, career planners, researchers, and policy makers.*

The new SOC will be useful to users only insofar as the information included in it is reliable and up-to-date. Obsolescence of DOT titles and occupational information is one of the major problems identified with the existing DOT/SOC. There are several reasons for this, which have been discussed elsewhere. If all users of national occupational data were served by a single, unified occupational classification system, which linked occupational and labor market information, system maintenance and revision would likely be encouraged by users who depended on the system for current information. Linking occupational and labor market information would help ensure that data collection efforts in both spheres proceeded concurrently, provided that the benefits of directly relating the wealth of labor market information with occupational information were established as a main goal of the system.

Table 14. Contents of DOT/SOC database

Core information	• Complete revised SOC • Complete DOT
Data sorted by occupation	• Crosswalk between DOT/SOC occupations and those used in the military. • Wage information by occupation by area. • Gender mix and ethnic composition of occupations by area. • Occupation/Industry matrices by Area/Region/State, with employment projections by employment by occupation. • Related or comparable occupations shown in ladder or matrix form. • Training requirements by occupation (educational level, courses required, apprenticeships available, and list of school offering programs leading to the occupations). • Physical requirements: lists of occupations suitable for people with disabilities, both physical and mental. • Individual occupational guides: briefs covering one occupation or group of occupations. • Catalogue of educational and training facilities providing work-related training, sorted by occupation. • Licensing requirements by occupation, and where to obtain them. • Data from Unemployment Insurance reports by geographical area, showing occupation, gender, length of unemployment, etc.
Related data items	• Guides for use by Social Security personnel to help in referral to jobs or training, and to assist in decision making for disabled claimants. • Guide to use in application of the Occupation/Industry matrices. • Rules, regulations, and statutes covering worker's rights, including contents of Fair Employment Practices Law. • Guides to Affirmative Action policies related to specific areas. • Guide to rights of people with disabilities, including requirements for reasonable accommodation and its meaning. • Immigrations rules relating to the importation of workers. • Directory of government and private agencies dealing with various aspects of the labor force, labor market, employment, unemployment and related subjects. • Guides on improving job search skills.

Dissemination and publicity

• *Incorporate more user-friendly methods of data presentation.*

If data could be presented in more user-friendly forms, made widely available and at reasonable cost, end use would undoubtedly increase. Suggestions for more user-friendly and more feasible and practical methods of information dissemination include:

1. Customized reports, tables, briefs tailored to individual needs.

2. Computer libraries containing occupational briefs or detailed occupational and job descriptions including full worker traits data, wage information, industry attachment, mobility patterns, and employability assessment.
3. Computer tutoring systems to teach users how to find and retrieve information in specific formats.

Such relatively simple solutions to packaging and using occupational data do not touch on the greater problems: the availability of time, money, and qualified staff to obtain and maintain the data, and the requirement for constant updating and validating of the data.

• *Develop a new approach to publicizing and marketing the revised SOC.*

The SOC is certainly not as well-known nor as widely used as the DOT. Obviously a different approach is required for it to make a worthy contribution to achieving important national goals for the workforce. Past dissemination of the SOC has been through customary in-house distribution of government publications and subsequent sale to other potential users. The Government Printing Office which prints, binds, and handles the distribution of the SOC, along with all other government publications, has a basic set of orders which is filled automatically. For example, copies are bought for and sent to all State Employment Service offices and to other agencies which should be using the publication.

In order to develop an effective and broad-based publicity strategy which will encourage interest in and especially use of the SOC, a first step would be to include in the budget for revising the system sufficient funding for a professional advertising and marketing program. Suggestions for inclusion in such a program are:

Advertisements placed in trade journals and other publications directed towards:

Vocational Educators
Counseling Interviewers—school rehabilitation, career, etc.
Personnel administrators
Lawyers and Physicians
Educators at all levels
Libraries, College and university; public libraries.

These advertisements should be prepared by professional copy writers and offer stimulating descriptions of the SOC and its uses, as well as information about the media in which it is offered (hard copy, computer tapes). The publicity campaign should include television advertisements, which might be available for free as public service announcements; newspaper stories; and references in speeches, especially by staff of the Department of Labor and other involved agencies. Notice should be given of the availability of instructional materials, training programs to be offered in the local area, user manuals, and computerized "help" and "how-to" menus. Advertising placards should be devised and distributed to libraries, schools at all levels, employer groups, unions, vocational and career guidance centers, public employment service offices, private schools, social security offices, and post offices.

Individuals in each state should be trained to serve as master trainers in the use of the SOC and related materials. And a customer-service representative should be available, preferably on a toll-free number, to take orders for the SOC, describe its contents and uses, refer potential users to related materials, and provide technical assistance in answering questions from users.

Table 15. Summary of all recommendations by classification issues

Recommendations Related to Choosing Variables

- Distinguish between sorting variables (to be used in defining occupations) and supplementary variables (to be part of a database) for both the DOT titles and the SOC basic units.
- Consider the societal goals identified in Table 1 (in Part A) in selecting variables.
- In choosing variables, incorporate the criticisms and suggestions generated by the various critical reviews of the occupational classification system in recent years.
- Use sound theoretical principles in electing variables and rating schemes, incorporating the latest work in cognitive science, psychometric testing and evaluation.
- Consider demands for customized aggregations when selecting SOC descriptor items.
- Ensura that information elements included in a SOC database meet the major needs of workers seeking placement. Incorporate a wide range of skills-related information including indicators of cognitive requirements, complexity, responsibility, training requirements, and specific hiring criteria.
- Review the measurements of skill and consider the relationship between actual and objective skill requirements.
- Include measures of occupation specific and transferable skills in the sorting variables for the DOT and the SOC. Ensure that the SOC basic occupational units contain information elements that facilitate skill transferability.

Recommendations Related to Defining Occupations

- Define the SOC basic occupational unit (unit group) by specific variables (descriptor items) rather than only in terms of its component DOT titles.
- Reduce the number of DOT titles by performing a computerized analysis of DOT occupational descriptions and ratings to identify titles to be merged.
- Set the broad parameters for the total number of SOC unit groups with referance to the data needs and data collection capacities of the Census Bureau and the OES. Consider also the total number of categories in ISCO-88 and the Canadian systems.
- Base the definitions of occupations on consistent principles.
- Use a combination of broad skill levels, authority, and work fields to construct a matrix of occupations.
- Use census data on employment levels by occupation to select redundant and obsolete DOT titles for elimination.

Recommendations Related to Aggregating Occupations

- Design aggregation of occupations into broad clusters (which will be relied upon where occupational data must be aggregated to protect confidentiality at fine geographic scales) to meet the needs of all uses.

Table 15. Summary of all recommendations by classification issues—Continued

Recommendations Related to Developing a Database

- Collect occupational and labor market information using the same occupational classification system. Coordinate the occupational structure used in the OES and US Census of Industries and Occupations to generate a single set of occupations, obviating the need for crosswalks.
- Contribute to public policy through research using occupational information that is reliable, comprehensive, consistent, clearly defined, and comparable with other data sources.
- Incorporate recent developments in geographic information collection, management, and analysis in the form of GIS.
- Make full use of opportunities for linking occupational information from a number of sources.
- Ensure that occupational classifications used in the *worker-based* information sources (such as population census) match (as much as possible) the *job-based* sources (such as data from firms).
- Consider current sources of worker or job data with a spatial component as potential participants in a future labor market database forming part of a GIS analysis.
- Integrate wage and claims data showing earnings and employment histories of workers with job service occupational coding data showing the classification codes for previous and placement occupations of individuals receiving public employment services.
- Integrate occupational matrices, jobs listed with the public employment service, and ES-202 data.
- Design sampling methodology for a new SOC that corrects the sampling biases of the DOT. Base sampling design on the sectoral and geographical distribution of industries and occupations.
- Collect occupational information through a combination of surveys, interviews, and job observation.
- Collect *local* labor market information for worker-job matching and occupational and labor market research.
- Coordinate efforts by national, state, regional, and local agencies to collect and disseminate labor market information.
- Emphasize the potential (or "should-be") users of the SOC system as well as those who are actual or typical users.
- Design a database that is comprehensive and accessible.
- Update and revise the SOC on a regular basis, in order to maintain its currency and usefulness to workers, career planners, researchers, and policy makers.

Appendix. The Distribution of DOT Titles by SVP Groups and DOT Occupational Categories

The role of skill measures in the definition of an occupation in the DOT is ambiguous. On the one hand, the DOT attempts to group occupations on the basis of type of work; measures of skill (SVP and GED) are presented as relatively independent items of information assigned to the occupation. However, a simple analysis of the relationship between DOT occupational group and SVP shows evidence that SVP scores are systematically related to the classification of occupations.

The relationship between the SVP ratings, and the nine one-digit occupational categories in the DOT reveals some interesting patterns. Tables 16 and 17 show the distribution of DOT titles by one-digit occupational category, cross-tabulated by their SVP rating. SVP ratings were aggregated into four broad groups to simplify the analysis: a "High-Skill" group (SVP = 8 or 9); a "Upper-Middle Skill" group (SVP = 6 or 7); a "Lower-Middle Skill" group (SVP = 4 or 5); and a "Low-Skill" group (SVP = 1–3). Based on the SVP ratings, occupations in the High-Skill group require at least four years of vocational education, training, and/or work experience, while occupations in the Low-Skill group include entry-level jobs demanding only 3 months or less of vocational preparation.

The most striking cases of the relationship between occupational category and SVP rating occurred among Professional, Technical, and Managerial occupations, and in the high skill (SVP=8, 9) and low skill (SVP=1–3) occupations. The Professional, Technical, and Managerial category is overwhelmingly clustered in the higher skill levels, with only 6 percent of its DOT titles with an SVP of 5 or lower. In each of the other occupational categories, most DOT titles have SVP ratings below 8. In only one case (Structural Work) did the share of DOT titles with an SVP greater than 7 exceed 10 percent.

Nine percent of all DOT titles are in the High-Skill group (SVP = 8–9). Most of these titles are in the Professional, Managerial, and Technical occupational category (66 percent). The handful of Structural Work, Benchwork, and Machine Trades titles with an SVP of 8 or 9 included both skilled craftsmen and supervisors, such as Electrician, Refrigeration Mechanic, Furrier, and Optician. The processing occupations in this group were dominated by supervisors, with only four exceptions (Almond-Past Mixer, Grease Maker, Head; Head Operator, Sulfide; and Refinery Operator). The Miscellaneous category included a large number of jobs in the printing and publishing industry, which has similar patterns of apprenticeship and craft rules. The service jobs with high SVP were almost all in protective services, including Fire Chief and Police Chief. Among the few examples from other industries was Pastry Chef. The number of clerical and sales jobs with this SVP rating were minimal; they included mostly supervisors (for example, Head Teller).

A plurality of DOT occupation titles (5,333, or 42 percent) are located in the Low-Skill group (SVP = 1–3) and contained fairly large shares titles from all occupational and categories except Professional, Technical, and Managerial occupations. The few Professional, Technical, and Managerial occupations found in the Low-Skill group are mostly in Amusements and Recreation (for example, Horse Exerciser, Psychic Reader, Show Girl) and in other services (for example, Museum Attendant). One-third of the Low-Skill titles is a Processing occupation, highlighting again the overly-detailed coverage of manufacturing.

The manufacturing bias of the DOT is also described in tables 18 and 19, which present the number of DOT titles in major two-digit occupational divisions. Table 18 shows the occupational divisions with the greatest number of DOT titles, led by Food and Tobacco Processing, Chemicals (and related products) Processing, and Textile and Leather Products Fabrication and Repair. These three divisions together have 2,036 titles, 17 percent of all DOT titles. In table 19, clusters of DOT titles are shown, based on two-digit occupational division and the four SVP Skill Level groups defined above (therefore each occupational division consists of four skill-level groups; there are a total of 328 such groups in the DOT). The most telling fact here is that the seven skill/specialization clusters with the most DOT occupations are all low-skill manufacturing groups.

The purpose of such a detailed DOT is to provide a dictionary covering all occupations. However, the skewed distribution of DOT titles represents a highly detailed coverage of manufacturing occupations. The greater the specificity of defining an occupation, for example, on the basis of tasks, the greater the likelihood that the occupation will disappear, due to task reorganization, technological change, and so on. This creates a paradoxical situation in maintaining the system: the highly-detailed DOT occupations require regular updating and revision, but their number precludes this. It is not feasible to keep tabs on 12,803 occupations on a regular basis.

This analysis reinforces the argument that SOC occupations should be classified on the basis of skills, authority, and specialization, rather than primarily on the basis of detailed tasks. Moreover, this analysis challenges the idea that the "type of work" related to an occupation can be distinguished from skill, authority, or work field. The only service occupations with SVP ratings of 8 or 9 are male dominated protective service occupations, though it is not clear why highly-skilled occupations dominated by women, including nurses and physical therapists, receive lower SVP ratings.

Notes

[1] This discussion of occupations as an emergent system is indebted to Waldrop (1992), pp. 118–20, 183–4, 278–9, 289, 322, 331.

[2] Labor market flexibility is in part a response to changing product markets. With intensified global competition, product demand is neither as stable nor as predictable as it was in the heyday of the postwar boom which ended in the early 1970s, forcing companies to adjust to frequent fluctuations in demand and market share. Consumer markets have become increasingly fragmented, with greater emphasis on customized products as opposed to standardized, mass produced products. This necessitates small-batch forms of production, creating incentives for companies to reorganize work tasks in such a way that workers can be readily redeployed between tasks as the need arises.

[3] The DOT philosophy of job analysis defines the following levels of aggregations: "elements" of work are grouped into "tasks"; these are grouped into a "position." Similar positions in different establishments are called "jobs" and the process of job analysis generates a definition of "occupation."

[4] Descriptions are from the *Dictionary of Occupational Titles*, Fourth Edition, Revised 1991. Washington DC: U.S. Government Printing Office.

[5] Large employers may use measures of abilities and personality factors in their hiring interviews, but their tests and criteria vary among firms, and the requirements are not usually made public.

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Uses of an Occupational Classification System

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Katherine Wallman, in her Presidential address to the American Statistical Association's 1992 annual meetings, reminded us of some aspects of attitudes towards occupational statistics. She related, when in preparation for the first decennial census (1790), James Madison, our fourth President, proposed collection of such data, only to have it rejected by the Senate because they considered it "a waste of trouble and supplying materials for idle people to make a book."[1]

It is not my intention to trace what has happened since, except to note how negative viewpoints and attitudes towards these matters (even the persons occupying those jobs) persistently crop up. Consider the 1850 decennial census, which did collect data on 323 occupations classified into 10 groups:

1. Commerce, trade, manufacturing, mechanic arts, mining
2. Agriculture
3. Labor not in agriculture
4. Army
5. Sea and river navigation
6. Law, medicine, and the divinity
7. Other pursuits requiring education
8. Government
9. Servants
10. Other

It almost never fails that my government colleagues, not to mention students in my university classes, when we reach this subject, respond to the fact that even then government workers joined servants and "others" in falling outside the pale of work needing education. Another (and final) example is the landmark work of Alba Edwards of the U.S. Bureau of the Census[2] and his famous six social-economic groups. Each group is characterized in a way similar to his description of professional personnel which would certainly warm the hearts of all those in that classification to this day: "More than most other workers engaged in purely intellectual pursuits, as contrasted with other pursuits directly related to the production, exchange, or distribution of material goods . . . are pursuing their occupations primarily because of true professional interest in their chosen fields of work, rather than because of monetary considerations." Each group gets a description which Edwards considers warranted, ending up with unskilled workers who "are less well educated and more poorly paid . . . and being lower in economic status than the workers in any other group, they more frequently suffer from unemployment and become the subjects of relief. Inevitably, their views on social and economic questions are influenced by their form of life and labor."[3]

More recent occupational classification systems developed in the United States, for example, the 1980 Standard Occupational Classification (SOC), have moved away from this kind of approach. This is indicated by its "Principles of Classification" among which we find, "An occupation should be classified on the basis of work performed. Skill level, training, education, licensing, and credential requirements, usually associated with job performance should be considered only when an inaccurate picture of the occupational structure would be presented without such consideration." Among other classification principles overtly made in the 1980 SOC is that "Place of work (industry) should be considered in classifying an occupation only when the work setting alters the nature of the work sufficiently to warrant separate classification."[4]

In attempting to formulate some conceptual structure for the uses of an occupational classification system, I find that in the real and complicated world of work, when confronted with the real and complicated world of people, it is difficult to marry such principles and practice. I venture to present the following points aimed at bringing the two together.

Such factors as education, training, and skill which are to be eschewed, if at all possible, according to these principles, nevertheless, seem almost omnipresent in the SOC or its close kin, the Industry-Occupation Matrix of the Bureau of Labor Statistics (BLS). For example, it is difficult in real life (and even in a dictionary) to distinguish between "skilled" and "precision" workers (the latter, of course, being part of the current system's terminology).

The *SOC Manual* itself :

1) Carefully distinguishes between "top level" and "middle" management, and adds, "Workers in this division are not directly concerned with the fabrication of products or with the provision of services. They require a knowledge and the capacity to put into effect management principles, prac-

tices, and techniques rather than those of a scientific or other specialty."

2) Notes for the teacher, librarian, and counselor group that "These occupations frequently require a certificate for which a bachelor's degree is the usual minimum requirement."
3) Declares that it is important to be concerned with "the application of scientific and mathematical knowledge to the conduct of research and development" when dealing with the natural scientist and mathematician group.
4) Specifically calls attention to the fact that the amount of training for the exercise of these occupations "is substantial, in most cases at least 6 months to a year and in many cases several years" when it describes precision production occupations.
5) Contrasted with handlers, equipment cleaners and laborers, "Who are concerned with performing routine, nonmachine production tasks involving minimal judgement . . . these jobs require only a minimal amount of general educational development." (Skill level, training, education, licensing, and credential matters certainly loom large here.)

I must also say that I have yet to see (although I cannot claim to have seen every tabulation made in this area) a table on these matters which does not begin with executive and managerial occupations, moves on to the likes of engineers, life scientists, diagnosing occupations, and so on, all the way "down" (my word) to handlers, helpers, and laborers. (I would like to say that this was called to our attention by some in the focus group with whom we conducted our research.) In the two tables we will be presenting shortly—on health and transportation—we deliberately started and ended the opposite way so that we can all see what it looks like. It is impressive also to see the significant amount of industrial detail in current classification systems, despite the principles of classification: Sales; agriculture, forestry and fishing, separate breakouts of communication occupations under administrative support/clerical as well as precision workers; as a separate block for the construction trades, among precision workers; the same for printing, textiles, apparel, furnishings, and woodworking; and among production work—auto, rail, and water transportation occupations getting separate billing; and so on.

These comments should not be taken as some critical indictment of the current systems. Indeed, as will be seen in what we put forth, we think this is the way to go. From the very beginning of work in this field, it has been very difficult to compartmentalize industry and individual occupations. While it is certainly apt to view the industrial and occupational world in their separate aspects, I share the idea that a clear cut separation of the two, in telling the occupational story, injects a serious element of artificiality. It will, therefore, not be surprising to find that our materials designedly pay attention to the industrial context, no matter what they are called—groups, fields of work, occupational families, and so on.

When all is said and done, however, the major force which differentiates this paper revolves around the key point in current principles of classification: *An occupation should be classified on the basis of the work performed.* Like all good general principles, this one refrains from going into detail and consequently leaves a substantial amount of room for specifics. Is the kind of product or service involved relevant? Are the kinds of materials used pertinent? Are the kinds of transactions with different machines, techniques, processes, and ideas important? What are the levels of those transactions? (But skill level is generally out of bounds) All of the above?

In seeking an answer we gave great weight to another principle in the SOC's list regarding the role of industry which, as indicated before, is relevant if it really makes a difference in the work setting in which the occupation is found. As an example, consider the contrast between a cook in a private household and a cook in some commercial setting.[6]

Those who read on will see that we find words like "work settings" quite beguiling and of great importance to the matter of occupational classification. Accepting the importance of the nature of the work performed means giving priority of the highest order to the environment—the setting in which people in a given occupation work. This includes giving major importance to the interplay—the interaction prevailing among people working in different, related occupations in the arena in which that work is being performed, whatever the skill, education, work credentials, and so on, are involved. It might include going even further, even if it means classifying laborers, precision workers, and managers in the same group.

To go along this route results in many major changes from current practice:

• Medical and legal secretaries shift to work settings in which they belong (health and law and protective service, for example) from administrative support/clerical, operating in completely different environments affecting the very nature of their work.

• We do violence to the time honored classification of engineers, for example, placing mining and petroleum engineers in the energy group, just about 180 degrees away from, for example, aeronautical and astronautical engineers, from which they literally are.

• School bus drivers move out of the transportation group where they now keep company with taxi drivers, light and heavy, to education, where they interact with school children, school teachers, school boards, school parents, and so on.

Many more such changes will be covered later.

Because our focus here is on the use of occupational classification on trends in occupational employment, the industrial setting is of prime importance. This is fortified by a recent BLS publication which contains data on the prospects between 1990 and 2005 among various occupations in each of the 40 industries covered.[7] Indicative are the enormous differences in the job outlook for the very same occupations among the various industries. For example:

- BLS projects a 6-percent decline among bookkeeping, accounting, and auditing clerks, but a decline of 30 percent in food processing and a 42-percent increase in computing and data processing for the same occupation.
- A prospective 7-percent increase in blue-collar worker supervisors is accompanied by a 25-percent increase in air transportation and a 40-percent decline in telephone communication.
- Chemists are scheduled for a 16-percent employment increase over 1990-2005, but an increase of only 2 percent in chemical manufacturing, except drugs, and a 30-percent increase in drug manufacturing.
- Among graders, dozers, and scraper operators the overall outlook is for a 11-percent upturn, but a 12-percent decline in mining and quarrying and a 19-percent increase in manufacturing.

Finally for these introductory, although very important, explanatory points for the substance we will offer, I would like to say that it never fails that I get asked in classes (course title: "Employment, Unemployment, and Public Policy") why someone so learned and steeped in occupational lore as Dr. Alba Edwards included pharmacists together with hucksters and meat cutters (except slaughter and packing house) in his socio-economic group of proprietors, managers, and officials. What brought together decorators and window dressers, traveling sales representatives, bookkeepers, and building superintendents under the rubric of clerks and kindred workers? Why sheriffs, bus conductors, and firefighters joined mechanics and cabinetmakers as skilled workers, while elevator operators found themselves in the unskilled category under the subhead "servant classes."

My answers, for better or worse, always contain the point that half a century has passed and that is a long enough time for everything from attitudes to technology to social and economic structure to change. I do not know, of course, how we will all look to a class 50 years hence, but I do think the current classification systems will stand the test of time as reflectors of the milieu they serve. In the materials we present below, we underscore the differences with those systems, because the point of this exercise is to show that those systems can be used substantively and to show the alterations that may be considered in making them more amenable to those uses. This should not be taken to mean that what has been formulated in the past couple of decades in this field has not represented important progress in the evolution of this work.

I use the word "evolution" deliberately, also in viewing the current systems as a viable point of departure, a take-off point for future growth, trying to read the restless tea leaves under the current impact of almost day-to-day upheavals in technology and occupational and industrial structure. It is difficult to believe that this ferment will leave these structures untouched even in the immediate years ahead. Involved, for example, is the huge move from the goods-producing to the service-producing sector. That alone is a big factor in taking into account the interrelating, interacting relationships of the various specific occupations which we think are so important in building an occupation classification system. In Philadelphia City, where this is being written and where the work being described here is taking place, about 70 percent of employment was in the service producing sector 20 years ago; it is now 90 percent, with about 1 out of every 8 workers (13 percent) just in the health services alone. Our more detailed exposition on the health field and how it illustrates the importance of those interactions nationwide will be found in the next section.

In the first of the principles of classification under the 1980 SOC to which we have now referred a number of times, the goal is stated as follows: "The classification should realistically reflect the current occupational structure of the United States."[8] It is hard to argue with such a principle, just as it is difficult not to point out that by that very token, subsequent occupational classification systems are going to have to take into account some major alterations in concepts and substance in order to continue to abide by that principle—unless change somehow stops taking place.

In this section we start by noting that we use Bureau of Labor Statistics (BLS) projections of occupational employment in its most recent effort for the period, 1990 to 2005, to make concrete the move to an alternative user's occupational classification system.[9] We have used these materials in our research on this subject involving work with focus groups of students, teachers, and guidance counselors. They ranged from sixth graders to college graduates to displaced men and women from the recession, as well as in implementing a recent major foundation grant which will be described briefly later on.

We have classified the approximately 500 occupations involved into 21 fields or family groups. Each group embraces a wide variety of skills, methods of production, types of services, and so on. Primacy is given to the interaction prevailing among the workers included in each classification. To save time and space we briefly describe the 21 groups, citing some specific examples for each, but give the complete array for only 2 of them. We

expect to make all of the detail available in early 1994, based on the new projections expected from BLS this fall. The detail we have now is available to anyone who is interested.

A brief description of each family group follows.

1. *General management and administration.* This group includes managerial and related jobs not tied to some specific field of work as well as those which are part of and support the general managerial process. Included, for example, are the general managers and top executives in private industry and government, as well as personnel specialists, and blue-collar worker supervisors. Excluded are such occupations as education, financial, food and lodging manager, each of whom are classified in their respective fields of work.

2. *Finance.* Included in this group are accounting, finance, and insurance—three major fields which impinge on each other and include all workers who interact with each other in providing the services. Workers range from accountants and cost rate clerks, financial managers and loan officers, to underwriters and insurance claims clerks.

3. *Engineering and Science.* Engineers and their technicians, scientists and their technicians whose jobs are not tied to some specific field of work are found in this group. Thus, civil engineers will be found in the construction complex and petroleum and mining engineers in the energy field.

4. *Mathematics and computers.* This group brings together mathematicians, systems analysts, statisticians, operations research analysts, as well as data processing equipment repairers and numerical control programmers involved in the development, production, repair, and use of computer-related technology.

5. *Health.* Illustrated in detail here, this group includes 41 occupations ranging from the currently classified precision worker to professional personnel. They are, perhaps, the examples "par excellence" of the thrust of this exercise in showing the interactive context in the nature of their work performed around a major field of goods and services. Given where we are today and expect to be in the future in the health-care field, it is not surprising that only one occupation is expected to experience a decline in employment (EKG technician). This decline is due largely because other members of the health field, for example, nurses, are also operating electrocardiograph machines. That these occupations do indeed represent a burgeoning area of employment opportunity is illustrated by the fact that in 37 out of the 41 occupations the total job openings between 1990–2005 will amount to at least 50 percent of their 1990 employment (in 4 of them they amount to over 100 percent). The major part of the job openings will be generated by net replacement needs. All this can be contrasted with the scorecard for item 18 below—workers in the production of metal and plastic products. Their employment in 1990 amounted to about 5 million and represented all skill levels. Two thirds of the occupations are projected to decline in employment, many of them significantly.

The need and the demand for grouping occupations in this kind of format, based on the factors discussed, is illustrated by a substantial, multi-year foundation grant with which we are involved. The grant is aimed at developing and producing innovative, work-oriented multimedia materials to serve the needs of students who are not proficient in English. These students experience significant school drop out rates, traced in part to their poor English skills as well as a lack of understanding of working life in the United States. Such career information does not now exist for this group. Video tape, videodisc, and CDROM are some of the formats scheduled to be used. Bureau of Labor Statistics data on current and projected occupational employment trends will serve as the informational basis for this enterprise as they are for this paper.

The first product of this enterprise has been formulated and focuses on the health field. It centers around a half-hour docu-drama and illustrates the course of events a person experiences following a stroke—through treatment in the hospital emergency room, the hospital stay, and going home. The workers shown in this drama (with, of course, a bow to their employment outlook, courtesy of BLS data) include paramedics, ambulance drivers, doctors, nurses, medical secretary, physical therapist, occupational therapists, orderlies, medical assistants, a home health aide, and a psychologist. It illustrates very well the variety of skill and the types of services involved, with emphasis placed on the critical importance of the interaction among the various occupations providing goods and services in the health field. Similar materials are expected to be designed across the industrial and occupational spectrum with hope that they will be used and evaluated in actual guidance, counseling, and education and training activities in schools and related institutions.

6. *Education, training, library service.* One of the features that brings this group together, in addition to the nature of the work performed as we define it (including our favorite example of the school bus driver), is the critical importance of demographic trends and public policy in this field—for example, support for schools and libraries, in determining employment conditions and outlook which adds even more credence for this kind of grouping. We will talk more to the role of public and private policy in the field of occupational classification at the end of this paper.

Table 1. Health

Code	Occupation	Employment change: 1990–2005		
		Percent	Growth (000's)	Net replacements (000's)
PR	Electro-biomedical equipment repairer	51	4	2
PR	Dental lab technician	4	2	23
PR	Optical goods worker, precision	29	6	8
SV	Ambulance driver, attendant	20	3	2
SV	Dental assistant	34	60	60
SV	Home health care aide	92	263	73
SV	Medical assistant	74	122	23
SV	Nurse aide, orderly, attendant	43	552	287
SV	Occupational therapy assistant., aide	50	5	1
SV	Personal home care aide	77	80	26
SV	Pharmacy assistant	22	20	11
SV	Physical corrective therapy assistant., aide	22	29	6
SV	Psychiatric aide	34	34	21
AS	Medical secretary	68	158	71
T	Clinical lab technician	24	63	76
T	Dental hygienist	41	40	25
T	EEG technologist	57	4	1
T	EKG technician	−5	−1	1
T	Emergency measures technologist	30	27	12
T	Licensed practical nurse	42	269	168
T	Medical records technician	54	28	13
T	Nuclear medical technologist	53	6	2
T	Optician, dispensing, measuring	37	24	26
T	Radiologic technician, technologist	70	103	39
T	Surgical technologist	55	21	5
P	Dentist	12	25	63
P	Dietician, nutritionist	24	11	14
P	Medical scientist	66	12	9
P	Occupational therapist	55	20	12
P	Optometrist	20	8	13
P	Pharmacist	21	35	56
P	Physical therapist	76	67	29
P	Physician	34	196	208
P	Physician assistant	34	19	13
P	Podiatrist	46	7	6
P	Psychologist	64	79	14
P	Recreation therapist	39	13	11
P	Registered nurse	44	767	404
P	Respiratory therapist	52	31	20
P	Speech, language, pathologist, audiologist	34	23	23
P	Veterinarian	31	15	17

Source: Data in this table and table 2, Moving people, goods and services, are from U.S. Department of Labor, Bureau of Labor Statistics, *Monthly Labor Review*, November 1991 (Volume 114, No. 11), "Occupational Employment Projections," by George Sylvestri and John Lukasiewicz, table 2; and U.S. Department of Labor, Bureau of Labor Statistics, Bulletin 2401 (May 1992) *Occupational Projections and Training Data*, particularly tables 6 and 13.

Codes for both Tables: AS=Administrative support/clerical, HL=Helpers, laborers and material movers hand; OP=Operators, fabricators; P=Professional; PR=Precision production, craft and repair occupations; SV=Service; T=Technicians; TR=Transportation, material moving machine and vehicle operators; S=Sales.

Note: These three columns of data are part of a seven-column display for each occupation to appear in our final tables. The final tables also include as the first two columns the data on actual employment in 1990 and projected employment for 2005, and a final two columns summing the total of employment change due to growth plus net replacements and a figure on that total as a percent of 1990 employment.

7. *The arts, entertainment, writing.* This is a group where the interrelationship among the various individual occupations is indeed very strong. Consider, for example the range of talents and activities subsumed under music or athletics. Perhaps the best way of describing this group is that the persons involved—the radio announcer or broadcast technician, the usher or ticket taker, the camera operator or the artist, the ballet dancer or ecdysiast—in presenting or communicating their wares to the public, or helping those to do so, through a host of media in a great variety of sites. Even motion picture projectionists appear here, plucked away from their current company with "cooking and roasting machine, operator and tender, food and tobacco" or "shoe sewing machine operator and tender" where they now reside.

8. *The law and protective services.* The increase in employment of paralegals and corrections officers was quadruple and triple the national average, respectively, and signals the trend for other occupations in this group. Included here are court clerks as well as lawyers, legal secretaries, and a range of police, sheriffs, and others, who are part of the legal environment.

9. *Social science, social welfare.* What brings this group together are their efforts to help design and carry through

public and private policy and programs to cope with demographic, geographic, social, and economic problems. These include economists, urban and regional planners, welfare eligibility interviewers, social or recreation workers, and child-care workers.

10. *Buying and selling.* Involves persons directly engaged in moving goods and services from producers to consumers, except for those doing the same for specific sectors such as insurance or the farm. A majority work at the actual point of sale, from the cashier who rings up that sale to the floor sales clerk and counter clerks with whom we transact—to get garments cleaned, rental cars picked up, or videos checked out. Other occupations include purchasing manager, and marketing manager, as well as freight and stock mover and hand packer and packager. In this group, too, is the whole panoply of real estate sales.

11. *Food, lodging, and personal service.* With about 40 percent of average consumer expenditures on food going to "eating out," the enormous amount of travel by residents as well as those from abroad, the significantly large move away from the home in the grooming process, it is not surprising again to find a relatively good job outlook for many of the occupations in this group. For example, at least a 33-percent increase in employment is projected by BLS for food service and lodging managers, hotel desk clerks, food counter and fountain workers, and short order cooks, as well manicurists. By the same token we find relatively large projected declines for private household cooks and cleaners and even a dip for the neighborhood barber, apparently giving way to the hairdresser and stylist.

12. *General clerical support.* This group is similar to our first group on general management and administration, and is composed of those not tied to a specific family of occupations where the remainder (and most) are classified. Included are such workers as receptionist, general office clerks, messengers, and file clerks. Categories such as these attest the proposition that there are always some occupations which cannot be neatly classified, no matter what principles or norms are used. These "outliers," however, at least under our rubric, represent more than that. Most represent occupations which are in transition because of changes in technology and many other affecting their jobs. For most of these occupations, the employment outlook is on the low side—for example, employment of typists and stenographers is expected to decline as the technology of the office changes; employment of messengers, file clerks, or in-house mail clerks is also subject to major technological changes influencing the internal flow of work in the establishment. Receptionist, where BLS projects an employment rise more than double the national average from 1990 to 2005, has for sometime actually been a shortage occupation. The very nature of the job has changed to where additional functions include computer operating, interviewing, and testing prospective employers, and often results in a career route to a managerial job.

13. *Farming, forestry, and fishing.* With not much more than 3 million workers providing all the food, feed, and fiber consumed in the United States (as well as what is exported), this is obviously a vital sector. Yet still further declines are projected. Forestry and fishing, too, face slow growth. In the context being developed here, this group also includes the agricultural and food scientist and the farm equipment mechanic whose efforts no doubt contribute to the increasing productivity in this sector.

14. *Communications.* Included are 10 occupations in the telephone and related fields which provide the communications network that ties the country and the world together. Nine of the 10 are projected to experience employment declines, most of very sizeable dimensions as dramatic and fast-paced changes in technology—from satellites to underground fiber optics—take place. Current classification systems put such occupations as central office operators or switchboard operators under "communication equipment operators" in the administrative support/clerical division; the rest are in precision production and craft and repair, dispersed under several headings. All of them are brought together here.

15. *Energy.* A little more than a dozen occupations are found in this group. These include nuclear, mining, and petroleum engineers; workers engaged in reaping energy resources through mines, wells, and gas fields; as well as those who make energy resources available to consumers. For most occupations, the employment outlook is on the downside, or growth is predicted to be below the national average.

16. *Moving people, goods, and services.* This category, also illustrated in some detail in an accompanying table, brings together workers in transportation in the context of movement by air, auto, rail, and sea and again, in each case, the gamut of workers related to each: Aircraft pilot, air traffic controller or aircraft mechanic in one; auto body repairer, tire repairer and changer, auto mechanic, or service station attendant in another; signal, track, switch mechanic, locomotive engineer or yardmaster in another; and able seaman or ship engineer in still another. Cutting across all of them we include travel agent and painter of transportation equipment.

This family of occupations also shows another dimension of what we mean by the major significance attached to the interrelation among workers in different occupations, clearly indicated by how each one is faring in this market. This can be seen by the cornucopia of minus signs attached to employment growth for 1990-2005 for

Table 2. Moving people, goods, services

Code	Occupation	Employment Change: 1990–2005		
		Percent	Growth (000's)	Net replacements (000's)
PR	Aircraft assembler, precision	6	2	14
PR	Aircraft engine specialist	22	4	6
PR	Aircraft mechanic	24	26	38
SV	Flight attendant	59	59	37
HL	Parking attendant	23	11	16
HL	Service station attendant	−7	−17	40
HL	Vehicle washer, equipment cleaner	23	55	49
TR	Bus Driver	24	39	33
TR	Taxi Driver	29	32	15
TR	Truck driver, light and heavy	25	617	592
OP	Tire building machine operator	−35	−5	4
PR	Auto body and related repairer	22	48	84
PR	Auto mechanic	22	166	329
PR	Bicycle repairer	11	2	3
PR	Bus, truck mechanic, diesel eng. spec	22	58	113
PR	Highway maintenance worker	24	37	29
PR	Motorcycle repairer	11	1	5
PR	Small engine specialist	9	4	18
PR	Tire repairer, changer	17	14	46
TR	Locomotive engineer	−6	−1	10
TR	Rr. brake signal switch operator	18	−6	10
TR	Rr. conductor, yardmaster	−14	−4	9
TR	Railyard eng, dinkey oper., hostler	−5	0	5
TR	Subway, street car operator	66	9	9
PR	Signal, track switch maintenance	−40	−2	1
TR	Able, ordinary seaman, marine oiler	−24	−5	9
TR	Mate, ship, boat, barge	−4	0	3
TR	Ship captain, pilot	1	0	6
TR	Ship engineer	−19	−1	3
OP	Painter, transportation equipment	34	52	40
AS	Reservation, transp. ticket agent, clerk	62	82	54

those working in rail or sea related occupations, and the very few if any minuses for those employed for or by auto and air transportation industries.

17. *Housing people, business, government.* The bulk of occupations in this group (40 of them) are the familiar ones associated with the construction trades which currently have their own listing under precision, craft, and repair; plus most of those now in the category "Material and equipment operators;" and construction trade helper, also now separately identified; to which we have added under our design such occupations as construction manager, architect, and civil engineer.

18. *Metal and plastic products.* This large group of occupations, to which we already have referred, is engaged in the design, layout, manufacture, and assembly of these products which involve a major sector of the manufacturing economy. It is also an excellent example of the interlacing operational relationships among their workers as the materials move from one stage to the next, from one level of operation to another, for example, set up operator to tender, from and to one level of tolerance to another, and so on.

19. *Wood and miscellaneous products.* This group of about 25 occupations encompasses workers who use an enormous variety of materials—wood, glass, paper, wax, leather, rubber, slate, clay, and so on—to make an equally enormous variety of products—furniture, tires, flatware, envelopes, candy, jewelry, and so on. Again, all levels of operations in the production process are represented.

20. *Textiles, apparel, and furnishings.* As is true in many of the other fields, this group is now scattered among precision craft and repair occupations, operators, and handworkers. For most of the occupations of this group the employment outlook is on the low side. When brought together, the listing does indeed show the different levels of similar occupations: Custom sewer, sewing machine operator, hand sewer pressing machine operator, tender, hand presser, and so on.

21. *Printing.* The various occupations brought together here are also currently scattered among precision workers, operators, and even administrative support/clerical personnel. This grouping documents further the illumination one gets by highlighting the impact of changing technology on related occupations. For example, projections for 1990–2005 show a 10-percent employment *decline* for letter press operators and a 34-percent *increase* for offset lithograph press operators.

Here is a recap of examples of classification changes between what is suggested here and current practice.

Occupation	Suggested	Current
1. Teacher aide	Education, library service.	Administrative support/clerical
2. School bus driver	Education, library service.	Transportation-motor vehicle operator
3. Driver/sales	Buying and selling	Transportation-motor vehicle operator
4. Blue-collar worker supervisor	General administration and management	Precision, craft, repair
5. Personnel clerk	General administration and management	Administrative support/clerical
6. Mining engineer	Energy production	Professional-engineer
7. Civil engineer	Energy production	Professional-engineer
8. Aeronautical, astronautical engineer	Moving people, business	Professional-engineer
9. Sheriff	Law and protective services	Service-law enforcement
10. Court clerk	Law and protective services	Administrative support/clerical—other
11. Legal secretary	Law and protective services	Administrative support/clerical—secretary, typist, steno
12. Broadcast technician	Arts, entertainment, writing	Technician-exc. health, sciences, engineering
13. Motion picture projectionist	Arts, entertainment, writing	Operator, fabricator-machine setter, set-up operator
14. Travel Agent	Moving people, goods, services	Marketing, sales occupations
15. Hotel Clerk	Food, lodging, personal service	Administrative support/clerical—information clerk
16. Host, hostess, restaurant, coffee	Food, lodging, personal service	Service-food and bar service occupations shop
17. Baker, bread and pastry kitchen work	Food, lodging, personal service	Service-cooks, exc. fast food
18. Farm equipment mechanic	Farm, fishing, hunting	Precision-vehicle and mobile equipment Repairer
19. Agricultural scientist	Farm, fishing, hunting	Professional-life scientist
20. Station installer, repairer, telephone	Communications	Precision-electric, electronic equipment
21. Telephone, cable, TV line installer	Communications	Precision-electric, electronic equipment
22. Parking lot attendant	Moving people, goods services	Helper, laborer-material mover, hand
23. Service station attendant	Moving people, goods services	Helper, laborer-material mover, hand
24. Vehicle Washer, equipment cleaner	Moving people, goods services	Helper, laborer-material mover, hand
25. Architect	Housing, people, business government	Professional-architect and surveyor
26. Metal pourer, caster	Metal, plastic products	Handworker, include assemblers, fabricators
27. Data entry keyer	Printing	Administrative support/clerical—other
28. Credit analyst	The financial world	Management support occupations
29. Purchasing manager	Buying and selling	Managerial and administrative occupations

As we come to the end, we note that we have attempted, by word, example, and some illustrative data, to make clear the importance of occupational classification systems to users of information concerned with occupational classification in their world of work. We also have suggested some arguments for a different set of principles for formulating the conceptual and substantive structure of those systems. We were aided (we would like to say without inculpating them) by the excellent BLS data in our particular field and, it ought also to be said, by the current structure's amenability which enabled us to reorder many occupations to illustrate our suggestions and ideas.

That the 1980 SOC, for example, lends itself to this kind of action is indeed made clear by its *Manual* to which we have so often referred. As examples, "Federal Government agencies will be encouraged to use the SOC for collecting occupational data, planning occupational education and training programs, planning occupational research analysis, planning and placement services, studying the mobility of workers and related activities dealing with occupational statistics," or "The system allows tabulations to be made for special purposes of data from different unit groups. For example, college and university teachers are classified by subject matter taught, which allows teachers to be combined with subject matter specialists, that is, chemistry teachers and chemists," or "Publication formats of occupational data should follow this structure for major tabular presentation, but recombination such as mentioned above are encouraged for supplemental analysis."[10] None of this, however, gainsays that we have strayed much further from this straight and narrow path.

Finally, we call attention to the emphasis on the key importance of occupational classification, that is, tabular presentations. They are often mentioned in the *Manual*, particularly the plain statement in its preface on page 4, "This system is designed for use in statistical analysis and presentation of data about occupations. It was not developed for any particular programmatic use."

Here, I think, is the overarching difference of the path we have followed. We think that something as important as this, representing a wide spectrum of social and economic developments affecting the world of work, should indeed take account of, respond to and serve public and private policy and program needs. We are encouraged that our proposed system does expose the interrelations among the various occupations, even to the point of making clear their employment outlook, sometimes significantly similar, often tellingly different. This, of course, does not mean that an occupational classification has to be bent to accommodate all facets of program needs, nor does it mean that programmatic considerations have to be bent to occupational classification systems. Deliberately keeping in mind the relationship between the two,

however, may be one of the next steps in the evolution in this field.

Notes

[1] Wallman, K.K. "Enhancing Statistical Literacy: Enriching Our Society." *Journal of the American Statistical Association*, March 1993, Vol. 88, No. 421, p. 4.

[2] Edwards, Alba. *Comparative Occupation Statistics for the United States; 1870 to 1940*, 16th Census of the Population, Washington, DC, U.S. Department of Commerce, Bureau of the Census. 1943, p. 179.

[3] *Ibid*, p. 180.

[4] U.S. Department of Commerce, Office of Federal Statistical Policy and Standards. *Standard Occupational Classification Manual 1980*, pp 8–9.

[5] *Ibid*, pp 32, 57, 69, 201, 345.

[6] *Ibid*, p. 8.

[7] *Career Guide to Industries*. U.S. Department of Labor, Bureau of Labor Statistics Bulletin 2403, September 1992.

[8] *Op. cit.*, p. 8.

[9] *Occupational Outlook Handbook*, 1992–93 Edition. U.S. Department of Labor, Bureau of Labor Statistics, Bulletin 2400, May 1992; *Monthly Labor Review*, U.S. Department of Labor, Bureau of Labor Statistics. November 1991, Vol. 14, No. 11; *Occupational Projections and Training Data*, Bureau of Labor Statistics, Bulletin 2401, May 1992.

[10] *Op. cit.*, p. 10.

Concepts for an Ideal Standard Occupational Classification System

Joel Popkin
Joel Popkin and Company

Executive summary

This paper develops and presents a three dimensional occupational classification system capable of serving a large segment of the users of the present Standard Occupational Classification (SOC). The recommended system also provides a framework into which many of the needs of users of the *Dictionary of Occupational Titles* (DOT) can be integrated. The three dimensions are used to classify occupations according to skill level, skill type, and industry. "Skill level" is used to describe the amount of ability and experience employees need to fill various occupations. "Skill type" is used to describe skills that are broadly representative of a group of occupations, for example, providing services in person. The third dimension of classification is industry, as defined by the Standard Industrial Classification. It is descriptive of the specific type of work.

The current DOT, and to a large extent, the SOC, define broad occupations by similarities in type of work. In the DOT, each occupation is further broken down by skill levels largely defined with respect to data, people and things, to use DOT terminology. The result is that it is difficult to obtain a cross-cut view of the labor force by skill level. That also makes it hard to assess the mobility of workers from one occupation to another, and to evaluate the level of training needed to effectively match the work force with jobs. The present system also makes it impossible to translate the changing composition of demand by industry into the impact on the demand for workers of specific skill levels.

The classification system proposed in this paper is designed to assist analyses of the transferability of skills across occupations. That type of information is valuable to most users of the DOT. Skill level and skill type usually circumscribe the extent to which employees can shift across occupations. Worker mobility is greatest across jobs within an occupation, but moving across occupations within the same skill level and type is the next most feasible option. For example, teachers and counselors are classified in the same skill level and type. The same skill type may cover a range of skill levels, representing yet another layer of worker mobility. Nurses may become doctors by acquiring a higher level of skill while practicing the same general type of skill. A movement across skill types, at the same general skill level, represents an additional possibility for worker mobility.

The ideal SOC may be thought of as a cube representing the labor force. Smaller cubes within the large cube represent the distribution of the labor force. Every small cube and the large cube have the same dimensional representation—one axis is skill type, a second skill level and a third, industry. An educational institution, or the Bureau of Labor Statistics (BLS) in projecting the occupational outlook, for example, would be able to determine where workers with certain levels of education, training, and experience are employed. The pressing job market questions of today, such as, the rate of return to education and training, the potential mobility of the labor force to shift jobs in responding to changing industrial structure, and the analysis of the kinds of jobs the U.S. economy is generating would be facilitated, at least conceptually, by this framework.

But can it be implemented? The report contains a section on implementation. The conclusion is that data can be collected to match the concept within the context of existing establishment-based survey systems, such as, those of the U.S. Department of Labor. It may be necessary, however, to first survey a sample of employers to learn about job content, particularly as it relates to defining skill level. But such a survey has already been envisioned by the Advisory Panel on the Dictionary of Occupational Titles (APDOT). A similar survey has been successfully conducted by the Canadian Statistical System to implement its new SOC which, not unlike the recommendations presented here, distinguishes between skill level and skill type. The Occupational Employment Survey (OES) program at the BLS could also be used to facilitate the collection of job content data that will reflect skill level differences across occupations.

A final aspect of this report is its recommendations regarding the hierarchical structure that should be used. The current SOC recommends broad categories such as one encompassing social scientists, social workers, religious workers, and lawyers. This broad category includes jobs not just of different skill types, but also of different skill levels. It reflects the problem a system confronts when it seeks to cover two aspects of occupations in one dimension. In contrast, the cube recommended here could be sliced in one direction by skill level. The number (the Canadians use four) of skill levels and their content must await a job-content like survey. With respect to the slices by skill type, this report recommends that occupations be grouped into information occupations,

those involving the transformation of goods and those embodying the delivery of services. This recommendation is intended to point the direction in which hierarchical structure should go. It should recognize key aspects of the changing labor market structure such as the growth of computers and informational jobs and the relative lack of mobility of foreign workers to provide in-person services here in the United States. But the precise nomenclature to be used should be considered further.

Finally, if it is assumed three broad skill levels will emerge along with three major kinds of occupations, and three major industrial sectors—goods producers, service producers, and distribution network industries, the ideal SOC can be envisioned as a cube with 27 major boxes, like a Rubic's Cube. And, of course, each box can be disaggregated further.

Introduction

Anyone old enough to have listened to the radio program "20 Questions" in which participants were asked to identify objects after being told only that they were animal, mineral, or vegetable, may have thought classification was easy. In fact, classification is more difficult (and more important) than commonly recognized. In the rush to use information, analysts typically accept the classification with which information is made available, usually not taking into account the extent to which their conclusions depend on the classification used and how it is implemented.

It is generally the case that the elements of a universe may be classified by any of a number of characteristics. Thus, it is important that the characteristic(s) selected be appropriate for the intended use of the tabulated information. The choice of the characteristic is also best accomplished by first establishing a conceptual basis. That is because the use of a classification concept will help insure that the data so classified are properly used (or recognizably misused). Further, the concept will provide data compilers with guidelines for their work and increase the consistency with which similar data are classified by different data compilers.

The purpose of this report is to set forth an occupational classification system capable of serving as a successor to the current Standard Occupational Classification (SOC). The recommended system will be referred to as the "ideal SOC." This research complements a recent review of the *Dictionary of Occupational Titles* (DOT) undertaken by the Advisory Panel for the Dictionary of Occupational Titles. The DOT Review Initiative, in cooperation with the Bureau of Labor Statistics (BLS), aims to provide a framework for a unifying occupational classification system.

Recommendations for an ideal SOC require making decisions about three dimensions of classification:

1) The unit to be classified;
2) The concept used to classify it; and,
3) The hierarchical structure of the classification system.

Once decisions have been reached about the unit, concept, and hierarchy, it is necessary to determine the characteristics of occupations or of workers that should be observed and documented. In making these decisions, it is necessary to take account of the uses to which the occupational data will be put. In recent years, there has been growing interest, likely to accelerate, in the kinds of jobs the U.S. economy is generating and will generate in the future. This interest has been generated by debates on several issues: [1]

1) What are middle class jobs and are they disappearing?
2) Is the education system adequate to produce labor market participants with the human capital needed if the United States is to be competitive with other nations?
3) Has the pace of technology increased the speed with which new occupations are generated and established ones eliminated, so that workers will need to be prepared for several different occupations during a lifetime?

These questions raise the need to know about the human capital embodied in the work force and how it matches the needs of employers. They highlight the problem that the skills of the work force may not match those required for the jobs being generated. Implicitly, the questions also underscore the reality that occupations may be defined differently by employers and employees. The classification of occupations may differ depending on whether occupations are being viewed from the employee (supply) or employer (demand) side. The need to resolve this dichotomy has implications for any recommendations about the shape of an ideal SOC.

This paper presents a classification system that provides a framework for the organization of occupational data on the basis of skill levels and types in use in the labor market. Assembling occupational data on the basis of skills offers the important benefit of emphasizing the potential transferability of skills across different types of jobs. That type of information is lacking in the current SOC and, while available in one form or another, is somewhat difficult to extract from the DOT. Because the focus of the paper is on an "ideal" SOC, the analysis is mostly concerned with aggregates much broader than those considered in the DOT. Nonetheless, a disaggregation of the occupational hierarchy presented below would be consistent with the principles currently in use in the DOT and those recommended for future use by APDOT. While research at that level of detail is not undertaken in this paper, applications of the con-

ceptual principles are illuminated by means of a case study of detailed DOT occupations.

The next section of this paper contains a description of the existing occupational classification systems. Section 3 defines some terms that will be used frequently in the paper to characterize occupations. Sections 4 and 5 discuss the conceptual issues involved in the choice of an occupational classification system. Section 6 presents a recommendation for an ideal SOC, uses a case study to illuminate those recommendations, and discusses issues concerning the implementation of the ideal SOC. Section 7 concludes the paper.

The Existing Occupational Classification Systems

The DOT and the SOC are the best known of the occupational classification systems currently in use today. However, neither of these two systems is directly used to tabulate occupational data. Statistical data on occupations are collected instead according to the systems inherent in the Occupational Employment Survey (OES) and the decennial census. The census system is also used to tabulate occupational data in the monthly Current Population Survey (CPS). This section describes the basic characteristics of these classification systems.

The SOC was first published in 1977, but revised soon thereafter in 1980. The broad motivation for the SOC was to provide a standardized coding system and nomenclature for the various government agencies involved in the gathering of data relating to occupations. In addition, the SOC was intended to bridge the gap between the occupational classification that comprises the DOT and the classification system used by the Census Bureau when it takes the decennial census or conducts the monthly CPS.

The primary conceptual difference between the DOT and SOC is that the former classifies occupations by a larger number of characteristics, including the type of work and skill level required to fill them. The fourth edition (revised 1991) of the DOT contains approximately 14,000 occupational titles. The SOC classifies occupations according to the type of work performed and lists only about 600 separate occupational titles. However, those 600 or so SOC occupations are matched to about 12,000 to 13,000 DOT occupational categories. The SOC follows a fairly broad approach to classifying skill level, distinguishing only supervision from nonsupervision and delineating far fewer industry-specific occupations than the DOT. The finest level of detail in the SOC is a four-digit occupation.

An occupational system similar to the SOC is used by the Census Bureau to classify the occupational data it collects, along with other demographic data, from households in its monthly CPS interviews. The bulk of the occupational classes used in the CPS conform to the 3-digit SOC codes. The differences between the census classification and the SOC are minor and either system can be matched to the other without much difficulty.

Some of the demographic data collected in the CPS, such as years of formal education and tenure with current employer, are useful as proxies for the human capital employees may have brought to their jobs and obtained while working at them. Additional human capital characteristics are obtainable by matching regular CPS microdata with those collected from the same sample in periodic supplementary surveys. For example, such surveys have covered occupational tenure and sources of training subsequent to assuming current position. The Department of Labor is a principal user of CPS data. Among other things, it uses the data to assess the occupational distribution of employment and earnings. In general, CPS data are useful for assessing the characteristics of individual participants in the labor force.

The DOT provides the most detailed description of occupations available at the moment. A 9-digit occupational code represents the finest level of disaggregation in the DOT. The first three digits of the 9-digit DOT code are used to define an occupation based on the type of work performed and, if it affects the job content, the industry in which the job is located. The assignment of these digits is done in a way that is similar to how industrial classifications, such as the Standard Industrial Classification (SIC), define 3- and 4-digit industries.

The middle three digits of the DOT code focus on the level of skills used to perform a job. Basic job skills are defined with respect to what a job holder does with respect to data, people, and things. Data skills range from comparing data to synthesizing data on the job; people skills range from taking instructions to mentoring; and skills with things range from handling things to setting up. The DOT assigns seven skill levels to data, nine levels to people, and eight levels to things. Thus, in a 9-digit DOT code, the fourth digit refers to a skill rating with respect to data, the fifth digit refers to a skill rating with respect to people, and the sixth digit denotes the skill level with regard to things. The final three digits of the 9-digit codes in the DOT are used to differentiate, on an alphabetical basis, among occupations that have the same first six digits.

In the current version of the DOT, information concerning the use of skills is not confined to the occupational code. A "definition trailer" provides additional skills-related information in the form of any specific vocational preparation (SVP) and the extent of general educational development (GED) required to perform in an occupation. The GED codings reflect the needs for reasoning, mathematical, and language skills. Additional information on physical demands is also provided in the definition trailer.

The detail provided by the DOT and the attempt it makes to distinguish differences in skill level and type reflect its major use by government employment offices to match job applicants with job orders they receive. That is a very detailed task, requiring work at levels for which data are usually not tabulated. In addition to employment placement, DOT classifications are also used for purposes such as curriculum development, alien labor certification, and labor market research.

The DOT categories, however, are not directly put to use to collect and tabulate labor market data pertaining to occupations. As described earlier, the CPS tabulates data collected from households along divisions resembling the SOC. Employers, of course, are another source of data on occupational employment. The major vehicle for the collection of data from establishments is the OES. The OES, conducted by BLS, draws occupational titles and descriptions principally from the DOT. However, the OES occupational categories do not correspond exactly to either the DOT or the SOC and it is necessary to use a crosswalk to relate the OES to either of the other two classifications. Employers are not currently used as a source of information about the human capital of their employees. Of course, except for training for which employers pay, they are not apt to collect and tabulate much information about their employees' level of human capital. The information may be in the employees' personnel files, but it is not tabulated.

Some General Terms and Their Definitions and Uses

The purpose of this section is to introduce and define, in a general way, some terms that will be used intensively in the remainder of this paper. The concepts discussed are work content, worker attributes, job, occupation, industry, skill type, and skill level. Most of the definitions reflect current usage in the DOT or are adapted from APDOT recommendations. Specific adaptations of these terms for purposes of the "ideal" SOC are discussed as the need arises in the remainder of the paper.

Work content. A term introduced by APDOT, work content is the combination of basic activities and tasks that define what a person does at the workplace. These duties, and their objectives, typically define a job. However, the skills required to fulfill those duties are not necessarily job specific. Work content may be used interchangeably with "type of work."

Worker attributes. This term is intended to be descriptive of aspects of human capital or skills in use in the labor market. However, the DOT and APDOT define worker attributes in somewhat different ways. The main difference lies in the level of detail with which attributes are defined. There is also a subtle difference in perspective. APDOT defines worker attributes from the point of view of what a worker possesses or brings to the labor market. The DOT is, in empirical terms, an establishment-based system and defines these attributes from the point of view of occupational requirements. In other words, the DOT estimates attributes from the point of view of what a worker is required to use in the performance of a job.

The current DOT list of worker attributes begins with the level of complexity with which a job requires an individual to perform with respect to three basic functions: data, people, and things. These concepts were discussed in the preceding section. In addition, the DOT notes occupational requirements with respect to reasoning, mathematical, and language skills; specific vocational training; and physical demands. Except for specific vocational training, all other worker attributes noted in the DOT are required to some degree in all occupations.

In APDOT's view, worker attributes represent a continuum of skills-related information concerning occupations. In addition to the list of DOT attributes, APDOT includes years of education and work experience, and a detailed listing of personal aptitudes and abilities, such as, cognitive abilities and sensory abilities. APDOT also includes attributes that are best thought of as skill type attributes. These include occupation-specific skills (reading blueprints, operating milling machines, etc.) and occupation-specific knowledge (types of law, specific foreign language skills, etc.) Finally, APDOT includes a listing of personal qualities and interests.

Both the DOT and APDOT models concerning worker attributes are valuable tools for determining worker or occupational skill levels and types (see below). The APDOT model is more detailed, but as noted by APDOT, requires further research on the issues of specification and implementation.

Job. A job refers to the set of work-related tasks performed by an individual at his or her place of work. The set of tasks that comprise a job is employer determined and is a function of the organizational (production) structure at the place of employment. A job is establishment specific but several people may perform the same job, that is, the content of their work may be the same, at that establishment.

Occupation. An occupation is a collection of like jobs performed at more than one establishment. Occupations may or may not be industry specific. The jobs that comprise an occupation should be similar with respect to the main tasks performed, work objectives, worker attributes, and skill level. Because of these shared aspects with respect to human capital and work characteristics, individual mobility is greatest across jobs within the same occupational category.

Industry. In an occupational system, industry serves as a useful classifier for occupations that are industry specific. It adds to the description of the type of work required in those occupations. In the terminology of APDOT, industry provides "work context." For occupations found in a range of industries, the industry classification is necessary for an analysis of occupational mobility or the transferability of skills. Industry also provides a link between the demand for output and the labor requirements to produce that output.

Skill Type. The term skill type represents one dimension by which occupations may be aggregated. At low levels of aggregation, skill type may be synonymous with occupation and type of work.[2] That is the case when an occupation is unique with respect to its objectives and other work content requirements. Some other occupations may represent a natural hierarchy with respect to individual progression in the labor market. That is the case when occupations are linked together by similarities in tasks performed and work objectives but are performed at different skill levels. In other words, one occupation may represent the necessary training ground for another occupation that is performed at a higher level of skill. Thus, skill type, even at low levels of aggregation, may consist of a collection of occupations. Within a skill type, individuals may move from one occupation to another by acquiring higher levels of skills.[3] This type of mobility is not as easy as moving across jobs within an occupational group, but is easier than moving across skill types.

At higher levels of aggregation, skill types would be defined on the basis of general, as opposed to occupation specific, forms of human capital, work objectives, and/or work attributes. For example, the master titles and term titles defined in the DOT and SOC, such as, manager, consultant, etc., are skill types based on broad similarities in work objectives and attributes. The specific tasks, or the type of work, of managers and consultants may, however, vary across occupations. Designations such as blue-collar and white-collar are skill types that include an implicit reference to human capital.

Due to the conceptual nature of this paper, and its focus on occupational hierarchies, the term skill type will generally be used in its more aggregative sense. In other words, skill type will be used to denote a set of occupations linked together either by means of a natural progression in skill levels or other broad similarities in work objectives and/or human capital requirements.

Skill Level. Skill level refers to the range and complexity of worker attributes that are used in the performance of an occupation. The attributes used to define skill level should be used to some degree in all occupations. In other words, skill level should not be defined over attributes that are specific to a given occupation or skill type.

Skill level may be defined with reference to either a person or an occupation. There is an identity between the two when persons of a given skill level are employed in occupations requiring that skill level. However, there often are exceptions because individuals may be hired to perform jobs for which they may be under or over qualified. The discussion below defines skill level with reference to occupations rather than to persons. This approach is consistent with current empirical practices in the DOT. Another advantage of this approach is that occupational requirements and attributes are generally easier to observe and quantify than personal aptitudes and abilities. The approach described below is also fully consistent with the less aggregative approach recommended by APDOT. A link between the detailed APDOT recommendations and the concepts explored below may be established as those recommendations are tested empirically.

Skill level may be defined by considering the human capital requirements of occupations and the complexity of other worker attributes that must be used in an occupation. Human capital requirements are the years of education, training, and experience that are required of an incumbent in an occupation. The current version of the DOT lists several pieces of information for each occupation that may be used to determine skill level. The complexity of tasks may be determined with appeal to the DOT concept of data, people, and things (DPT) and general educational development (GED). As explained earlier in this paper, the concept of DPT refers to basic functions that must be performed to some degree in any occupation. In other words, people must interact with data, other people, and things to some extent in any occupation. Similarly, GED refers to the levels of reasoning, mathematical, and language skills that are necessary to perform in a given occupation.

The DOT has a ranking system in place that can be used to ascertain the level of complexity or skill with which each of these fundamental functions are used in an occupation. Thus, in the context of the current DOT, skill level would be defined with reference to the middle three digits of the 9-digit occupational code and the GED ratings in the definition trailers. The definition trailers also provide information on the amount of specific vocational preparation (SVP) required in an occupation. The SVP concept covers only job specific education and training and may be modified to include, or used in conjunction with, general levels of education and training.

Finally, it should be noted that skill level does not refer to the levels of efficiency with which individual workers perform on their job. For example, years of experience or job tenure can improve a worker's efficiency on the job. That can lead to movements up the promotion ladder and upgrades in wages. However, up-

ward mobility of this type is usually employer specific and does not necessarily enhance a worker's worth in the labor market at large. Evidence on this point is provided by Topel (1991). His research shows that workers with 10 years of (specific) job tenure would lose over 25 percent of their wages if they were to enter the labor market at large. In other words, job tenure may enhance a worker's value to a specific employer but it does not usually bestow the worker with a higher skill level that would be marketable elsewhere. One implication of this finding is that, while an individual's wage may reflect the level of performance on the job, it may not be a reliable indicator of that person's skill level with respect to attributes that are transferable across occupations.[4]

In sum, skill level refers not to how well a worker performs in a given occupation, but to the minimum level of requirements with respect to DPT, GED, SVP, and related attributes that are required for average performance in that occupation.[5] These requirements are attributes of occupations, but they pertain to skills required of workers. Of course, it is possible that the individuals actually working in those occupations may, at least on paper, be over or under qualified for those occupations. The maintained assumption is that if an individual is performing in an occupation, that individual possesses the minimum level of skill necessary to do so.[6]

Unit of Observation, Classification Concept, and Hierarchical Structure

The unit of observation, classification concept, and hierarchical structure are conceptual issues that are germane to any exercise in classification. This section describes how these issues impact the choice of an occupational classification.

Unit of observation

The first consideration in classification is deciding what should be classified. Should the unit of observation be people or occupations? Choosing the latter implies gathering a list of occupational titles and documenting the characteristics of those occupations. It leads to a classification of what people do or, at the least, what people are hired to do. In addition, one may document the skills required to perform on the job. Such documentation reflects the demand side of the labor market. However, classifying by occupations does not necessarily tell us what people are trained to do or are capable of doing. That requires the classification of people.

Individual labor market participants may be distinguished by their personal attributes. These attributes define the skills possessed by individual workers and are relevant to the ability of a person to gain employment or to be self-employed. However, an employer may employ a person at a job that only requires the partial use of that person's attributes. Or the employer may decide to hire a person on the basis of only one of the several attributes that person possesses. Thus, it is possible that persons may fall into different classifications depending on whether the unit of observation is the individual or the job. For example, a college graduate may be employed as a taxi driver but would not be classified as such based on personal attributes.

The foregoing discussion suggests that the choice of a classification unit partly depends on the anticipated use of the resulting classification system. Analyses of the demand side of the market would benefit most from a classification of occupations, whereas supply-side analyses would prefer the classification of people. Of course, it is likely that separate classifications for both units are needed to address the spectrum of issues raised about labor markets. An example of the need for data by both classifications is the analysis of the question of whether work force skills match job requirements. Such analysis is necessary to evaluate education and training needs.

Concepts relevant to classifying occupations

As noted in the previous section, classification is heavily influenced by use. That is because a classification is a framework by which information may be aggregated. If the information is economic in content, economic theory suggests various rules by which data points can be aggregated and the assumptions each approach implies about the underlying structure of economic activity. An excellent exposition of these approaches is found in Triplett (1990).

Economists, of course, are not the sole users of occupational classifications and the data produced using those classifications. Nonetheless, analyses of trends in occupational employment and returns to different occupations are a major preoccupation of most labor market analysts. Therefore, to start the search for an ideal SOC by examining what economic aggregation or classification has to contribute is not a misplacement of emphasis.

Economists typically articulate aggregation theories in the context of commodity markets, but those theories are readily applicable to labor markets. One set of theories stresses the extent to which different commodities (or labor services) offered for sale are substitutes for each other. This determination requires analyzing the markets in which they are sold and, thus, these theories are said to be demand-oriented concepts. Popkin (1991) has proposed a system for industrial classification based on the characteristics of markets in which the demand for commodities is satisfied.

In the case of labor markets, aggregation rules based on the demand for labor require an examination of the behavior of employers. If employers do not or cannot substitute workers with one set of skills for a set of workers with different skills, the two sets of workers are members of different occupational categories. If, in

the point of view of the employer, the two sets of workers are perfect substitutes, they are both classified in the same occupational category.

In the more typical case, substitution between jobs lies in between the aforementioned extremes. For example, a taxi driver may substitute for a bus driver, even if not perfectly. In those cases, a rule called functional aggregation may be used to determine whether taxi and bus drivers belong together as a single aggregate. Functional aggregation permits any class of partially substitutable workers to be combined if the rate at which they may be substituted for each other does not depend upon the employment levels of any other occupational groups. Thus, in a transportation company, taxi and bus drivers may be combined into a single category called "drivers" if one type of driver may be substituted for another independently of the employment of other occupational categories at the company.

In summary, the demand-side approach to occupational classification reduces to the proposition that if an employer considers a group of employees as a distinct factor of production—that is, a distinct input to the production process, such workers comprise an occupation.

Alternatively, one could think of classifying workers into occupations according to the skills they bring to the marketplace—skills reflecting the level and type of formal and informal education, experience, aptitude, analytical abilities, etc. This is analogous to classifying employees by the attributes they can potentially provide. This may be thought of as the supply-side approach. It is an approach in which the person, rather than the job, is classified. It is useful in quantifying the skills or human capital brought to labor markets and determining how they were produced and whether or not they match job requirements.

An approach which is neutral to the supply-demand issue is called the hedonic approach and was suggested by Triplett (1990). The hedonic approach would specify wage regressions with variables reflecting the kinds of skills workers offer. If econometric estimation determines that two sets of workers may be described by the same regression structure, those workers could be deemed to comprise a single occupation and a distinct factor of production.[7] For example, it may be the case that the attributes of bus and taxi drivers are valued identically in the marketplace. In that case, the hedonic approach would suggest retaining only one occupational category—drivers. The main drawback of the hedonic approach to occupational classification is that workers' characteristics that are valued in the marketplace—other than schooling and experience—are difficult to discern and measure.[8] In other words, it may not be possible to specify regressions sufficiently rich in explanatory variables to make accurate distinctions among occupations.

Hierarchy

Decisions about the unit of observation and the classification concepts will yield a set of categories that can be viewed as building blocks to form larger aggregates. It is possible to continue to use the concept underlying the building blocks to combine them. Or different concepts can be used. Some debate the need to adopt any particular aggregation scheme once building blocks are established—"users can roll their own." But important discourse on policy issues necessarily incorporates analysis and conclusions based on aggregates. A classification system—to be complete—should provide an aggregation framework for data users and providers. The aggregation framework should be structured to meet as many uses as possible.

The Conceptual Basis of the Ideal SOC

Background

Clearly, an "ideal SOC" should have a conceptual basis consistent with the use to which the resulting data are put. Because there are many uses, it is easy to conceive of multiple SOC's. One important distinction in use, and therefore in appropriate concept, is whether the analyst is interested in the human capital requirements of various jobs or in how the jobs are used by employers to produce output. Jobs that require similar attributes of their incumbents would be grouped together by the former approach.[9] However, the same jobs may be considered separate from the point of view of employers because of their unique roles in the production process.

These two fundamental approaches to classifying occupations based on human capital requirements or on use in production underscore the need to consider the use(s) to be made of the resulting data sets. The only U.S. study of this subject is one conducted by Westat of DOT users. (See Westat, Inc., 1993.) The principal users of the DOT fall into 10 broad categories. These categories of uses range from vocational counseling to curriculum development to employment placement. An important finding of the Westat survey is that all users of the DOT place considerable value on information pertaining to the basic skills required on the job. Related information on educational and other training requirements is also considered of high value. DOT users would also like to be able to group occupations by skill requirements as well as by tasks performed on the job. The general emphasis on skills on the part of DOT users reflects the fact most of them find it very important to be able to determine the transferability of skills across occupations.

The findings of the Westat survey are echoed in a survey the Canadian government did of users of its occupational classification system. Thus, the new National Occupational Classification (NOC) of Canada groups oc-

cupations on the basis of skill levels and types. Skill level is defined in the NOC as "the amount and type of education and training required to enter and perform the duties of an occupation" (see Employment and Immigration Canada, 1990). Other variables such as experience and the complexity of responsibilities are also considered in assigning skill level.[10]

The concern with skill level and type is also apparent in the experience of other countries. Besides Canada, the United Kingdom and Australia have also recently adopted occupational classifications based on skill level and type. Skill level and type are typically defined on the basis of years of education, experience, and nature of work. Skill level was also adopted as the major classification criterion by the International Labour Office (ILO), a United Nations organization, in its recent revision of the International Standard Classification of Occupations (ISCO). However, ISCO–88, the current ILO classification system, uses a narrower definition of skill level; it focuses only on years of schooling.

A classification system that provides more transparent information on skill level and type is clearly in demand. However, years of schooling and/or experience alone are not sufficient to capture skill level. Skill level and type were defined in the section on general terms above but are revisited in the section about the concepts for an ideal SOC under "skill level and type," below, in a more specific context. Subsequently, the choice of hierarchy section describes the choice of a suitable hierarchy and the following section discusses the choice of a unit of observation. Based on the principles outlined in these sections, a discussion follows that outlines the ideal SOC, presents a case study, and also discusses the feasibility of implementing the ideal with the present nature of statistical data gathering.

Skill level and type

The occupational classification systems that emphasize skill level and type have chosen to classify occupations on the basis of their requirements with respect to skill attributes such as years of schooling and experience. As mentioned, an extreme is the ISCO's use of years of schooling as the only criterion. However, reliance on these criteria alone is apt to produce less than satisfactory results. For example, on what basis does one compare the skill level of a manager with 18 years of education and 2 years of experience with that of a carpenter with 12 years of education and 10 years of experience? Clearly, if one were classifying workers on the basis of skill, the separation of these two individuals is possible only with appeal to some other criteria. These "other criteria" require articulation.

The limiting nature of schooling and experience suggests that it is necessary to find an alternative approach to classifying skill level and type. With regard to skill level, it was suggested above that the answer may be found in the DOT principles of data, people and things (DPT), general educational development (GED), and specific vocational preparation (SVP). These concepts may be supplemented by data on years of education and general labor market experience.

The DOT concepts underline the basic skills people bring to work. People create, gather and disseminate data and knowledge; they manage, interact with, or make strategic use of people; or they design or manipulate things to produce other things, whether or not tangible. Similarly, all jobs use reasoning, mathematical, and language skills to some extent. These notions of skill are generally independent of job or occupation type, or of type of schooling and experience. Specific vocational preparation may not necessarily lead to skills that are transferable across occupations. However, it is often substitutable with general education and it does represent a proxy for the complexity of tasks that must be performed in an occupation.

Given the basic skills that are used at work, it is now necessary to define the level at which they are used. The DOT currently has a scaling system in place to rank the level at which DPT and GED skills are used in a job. The DOT defines seven skill levels within "data," nine within "people," and eight within "things." Within GED, reasoning, math, and language skills are assigned six levels each, and specific vocational preparation consists of seven levels. These rankings provide the necessary raw materials, in conjunction with other data, such as years of education, to rank occupations by skill levels. As noted earlier, APDOT recommendations may lead to an even more refined and continuous spectrum of skill levels.[11]

The answer to the problem of defining skill types at higher levels of aggregation lies in the research of Reich (1992), Porat (1976), and Baumol and Wolff (see Osberg, Wolff, and Baumol, 1989). Reich is not concerned with the question of occupational classification but with the question of how job structures affect the way nations compete in global markets. One of his findings is that global competition has different implications for workers depending on their skill level and type. What is relevant for occupational classification from his research is the distillation of skill types to three essential categories: Routine production, in-person services, and symbolic-analytic. Routine production involves the routine and repetitive performance of tasks, whether it is on a factory floor or office building. The provision of in-person services may or may not be routine but is distinguished from other occupations by the requirement for direct interaction with the consumer of the services being produced. Finally, symbolic-analytic occupations are distinguished by their focus on the analytic use of information and/or knowledge to generate more information and knowledge.

The work of Baumol and Wolff, and Porat, also leads to the definition of three basic categories of workers and occupations. According to their terminology, workers are either information/knowledge workers, goods producers, or service producers. The main difference between the Reich and the Baumol-Wolff categories is that Baumol and Wolff are not concerned with the question of whether information related work is routine or symbolic-analytic. That may also be the case with regard to the production of goods or services. In sum, Baumol and Wolff divide workers and occupations primarily on the basis of their outputs, while Reich is additionally concerned with underlying similarities in the performance of tasks.

The concepts of skill level and type outlined above are suitable for use in characterizing any occupation. Thus, either skill level or skill type may be used to classify occupations or people. However, note that skill level and type are often interconnected. Some skill types inherently call upon a greater range and complexity of worker attributes than other skill types. Similarly, if occupations have been grouped together by skill levels, it may still be useful to differentiate among them on the basis of their skill types. In other words, it is best to classify occupations not by just skill level or skill type, but by both skill level and type. They would represent two dimensions of an occupational classification. The simultaneous representation of occupations across these two dimensions also recognizes the possibility that worker mobility across skill types is not the same as the mobility across skill levels.

The choice of hierarchy

The choice of hierarchy depends upon the particular characteristics of occupations that a classification system wishes to highlight. Occupations may be characterized by their skill requirements or by their work content. The former would emphasize the skill levels and types brought to or used in the marketplace whereas the latter would emphasize the structure of production used by employers. The distinction between skill type and work content is worth repeating here. Skill types are usually transferable across occupations and industries. Work content is usually descriptive of a particular job in a particular industry. In terms of current usage, work content may be used interchangeably with type of work and that will be the case during the remainder of this paper.

A focus on type of work performed leads to what may be described as a bottom-up system of aggregation. By this approach, information is first gathered on the finest levels of job requirements and then aggregated on the basis of similarities in the type of work performed. The DOT is such a system. The SOC, unlike the DOT, was not built on the empirical analysis of detailed job categories, but its structure is consistent with a bottom-up approach to aggregation. The type-of-work approach may lead to different skill levels climbing the same ladder up the occupational tree. For example, the 2-digit SOC category of Transportation Occupations includes airplane pilots as well as taxicab drivers. Thus, this system is not satisfactory in providing transparent information on the human capital content of the labor force. In addition, basing occupational schemes on types of work performed ties the system to production structures that are not generally stable. Thus, the current DOT overemphasizes manufacturing sector occupations at the expense of services or information related occupations.

A skills-based system of occupational classification leads to a top-down system of aggregation. Individuals would be first grouped according to the skill level and type they bring to the market, and occupations would be grouped on the basis of skills they require for average performance. As discussed earlier, skill types may be differentiated on the basis of as few as three yardsticks: Symbolic-analytic, services, and routine production; or information, services, and goods. Thus, the initial separation on the basis of skill type would consist of a very high level of aggregation. Simultaneously, skill levels could also be distinguished along as few as three or four categories. The Canadian system, for example, defines four skill levels.

A skills-based system would tend to break apart occupations even if they are similar with reference to type of work performed. Thus, a skill-level based system would lead to a scheme where the association between airplane pilots and taxicab drivers would be severed. An emphasis on skills would offer several advantages. It would illuminate not the substitutability (or lack thereof) among jobs—a form of knowledge that is useless to most users of the SOC—*but the potential transferability of skills across different types of jobs.*[12] The approach would also mean that the upper layers of aggregation would not be sensitive to the constantly changing nature of the production structure. Indeed, this approach would be quick to signal changes in the underlying structure of economic activity. For example, the increasing emphasis on the production and dissemination of knowledge would have been quickly revealed as a shift in employment from routine production to symbolic-analytic work.

The differences between the bottom-up and top-down approach should not be over stressed, however. Ultimately, the two approaches attempt to classify the same underlying set of jobs or workers. In fact, the two approaches are not substitutes but complements. That is because a skill based approach is best suited for a broad aggregation of occupations. The Reich system, for example, essentially permits three skill types. Given the apples and oranges problem inherent in comparing skill types, it is wise not to attempt a very fine level of detail with respect to skill types. Detailed occupational classes are instead best defined on the basis of type of work performed.[13] Thus, even a skills-based approach must

ultimately rely on the type-of-work approach. For that reason, the ideal SOC presented in the next section uses type of work as a third dimension of occupational classification.

The choice of a unit of observation

A classification system that is primarily based on the principles of work content or type of work performed would clearly use occupations as the unit of observation. However, a skills-based system could potentially use either people or occupations as the unit of observation. People possess the skills that are required by or used in the performance of occupational duties. More often than not, it will be the case that personal attributes and occupational requirements are in harmony and it is not necessary to make a distinction between worker and occupation. However, due to the potential for mismatches between workers and occupations, it is necessary to make a choice.

Two factors drive the choice of a unit of observation in favor of an occupation. First, direct information on the skill characteristics of workers is very limited. In principle, the information is collectable but no such data set currently exists. Second, the data that may be obtained from individuals may only serve general purposes. It may be possible to sort the supply of chemical engineers from the supply of heart surgeons, but how does one sort high school graduates by skill type? Ultimately, since most people only bring general forms of human capital to the labor market, people must also be sorted by the skills they practice on the job. In other words, many worker attributes, even if they are not job specific, are often obtained on the job.

Thus, for a skills-based system, it also makes sense to choose the occupation as a unit of observation. It is important to note that the characteristics of occupations that would be classified would generally be the characteristics of the workers employed in those occupations. The emphasis is on skills that are mobile with the worker and are transferable across occupations. In that sense, an occupation as a unit of observation is united in purpose with a person as a unit of observation.

An Ideal SOC

This section presents an occupational classification using the principles of skill levels and types. That presentation is followed by a case study of some existing DOT occupational categories to better illuminate the application of the classification concepts discussed in this paper. Finally, this section presents general guidelines for the implementation of the ideal SOC.

An ideal SOC with a focus on the characteristics of occupations with respect to skill levels and types is outlined in table 1. The structure described in table 1 is a top-down structure. It begins by categorizing three basic skill types—information, services, and goods. These skill types are based on the work of Reich, Porat, and Baumol and Wolff. Next, each broad skill type is broken down into three skill levels based on the principles contained in the current version of the DOT. Details on the choice of the three skill levels are provided below in this section. Thus, the ideal SOC would contain nine occupational classes at the highest level of aggregation.

Table 1 also shows how the major occupational categories currently present in the SOC would be classified under a skills-based SOC. The goal of table 1 is to present the basic hierarchical structure of an ideal SOC. The occupational titles listed in the table draw heavily on current nomenclature and are meant to be no more than suggestive. The use of existing titles, however, does serve to highlight the complementary nature of classifications based on skills and those based on type of work. The organizational structure in table 1 is based on skill levels and types but what it organizes is the myriad types of work being performed in the labor market.

The categorization of the three skill types is based primarily on the nature of work objectives or the nature of the output resulting from the performance of an occupation. Those distinctions remain in place despite the increasing spread of information-based technologies across all occupations and places of work.

Information occupations involve the creation, distribution, processing, storage, and retrieval of data, information, or knowledge. The end product of an information activity is generally more information. Information activities may involve the management of people, but that is generally done by the processing or strategic use of data. Similarly, information activities also involve significant interaction with other people, but again that is in the general cause of creating or distributing information. Information activities do not usually result in the direct creation or exchange of a tangible good or service.

Service occupations generally involve direct interaction with consumers either in the act of exchange or production. That coincides with the notion of in-person services as expounded by Reich. However, not all traditional in-person services are classified here as service occupations. For example, teachers, because of their information providing role, are not classified in table 1 as service workers.

Goods occupations are directly engaged in or are closely related to the extraction or production of tangible commodities but their work does not usually involve direct interaction with consumers. Another characteristic of goods occupations is their relationship to "things," either in their design or in their production. For example, engineers design plants and machinery for the production of goods and because of this direct interaction with the structure of production are classified as goods workers.

The three skill levels delineated in table 1 are based on the DOT concepts of DPT, GED, and SVP. At this

stage of conceptualization, no attempt was made to conform to the fairly detailed levels of skill ratings inherent in the DOT. Further research is required to devise and implement an objective scheme that would collapse the DOT data on various aspects of worker attributes into three skill levels.

The skill-level divisions in table 1 are based on subjective judgement. Skill level I is the highest skill level and skill level III represents the lowest level. The aggregation scheme implicit in table 1 was designed, in part, to illustrate some of the options offered by data currently available in the DOT. With respect to GED, the six levels of skills currently present in the DOT were subjectively collapsed to three as follows: High (levels five and six), medium (levels four and three), and low (levels two and one). Similarly, for data skills, levels zero and one are considered high; levels two to four are medium; and levels five and six are low. For people skills, high means levels zero and one; middle means levels two to five; and low means levels six to eight. For skills with respect to things, high means levels zero and one; middle means levels two to four; and low means levels five to seven. With regard to specific vocational preparation, levels one to five are considered low; levels six and seven mean medium; and levels eight and nine mean high.[14] Finally, an additional layer of judgement was imposed to combine together the various elements of skills implicit in DPT, GED, and SVP.

The assignment of skill level to some occupations is an easy task. For example, natural scientists, no doubt, are information workers of the highest skill level. The same is true of physicians as service workers and engineers as goods workers. However, some other occupations, based on their current definitions, are not that easy to classify. The current SOC classifies teachers into two categories—postsecondary and other. That is a type-of-work criterion. But not all postsecondary teaching occupations are created equal with respect to skill level. Teachers in graduate research institutions are, for example, required to perform creative research, but other postsecondary teachers may not have similar research responsibilities. Therefore, table 1 distinguishes between teachers based on their relationship to data rather than their place of employment. Teachers who also create and analyze knowledge are placed under skill level I, whereas teachers whose primary function is the dissemination of knowledge are placed in skill level II.

Some other occupational categories currently in existence also represent a collection of different skill levels. Transportation occupations, for example, are a collection of skill levels ranging from an airplane pilot to a taxi driver. Therefore, that group has been classified into three skill levels under the category of services. Similarly, routine library and archive occupations have been classified as "information storage and retrieval" occupations under the third skill level of information occupations to distinguish them from the high-skill group of librarians, archivists, and curators.

Just as the assignment of a skill level to an occupation is not always apparent, neither is the assignment of an occupation to one of the three basic occupational categories—information, service, and goods—always apparent. For example, transportation services may include the transportation of goods, an activity that does not require interaction with the ultimate consumer. Further, the transportation of goods transforms a key characteristic of goods—their location. For these reasons, some transportation occupations belong in the goods category. However, since the occupational characteristics of transporting people or goods are the same, all transportation occupations were preserved under the same umbrella group of service occupations.

The possibility that occupations may cut across more than one skill type or skill level suggests that it may be desirable to develop a system of primary and secondary activities as is currently the case with the SIC. For example, restaurant ownership/management occupations combine elements of information and service occupations. However, the occupation may be classified into one skill type—information—on the basis of its primary functions. At the same time, note may be made of the secondary skill type inherent in the occupation.

The occupational detail presented in table 1 is fairly broad and merely suggestive of occupational titles. Further detail may be realized by appeal to existing notions of type of work. Type of work can, in fact, serve as the third dimension of classification. For example, all supervisors are assigned to level II information occupations, but, within that aggregate, supervisors may be divided into smaller groups according to the type of work supervised. In other words, the ideal SOC would not distinguish between occupations that are similar with respect to skill level and type unless employers themselves choose to distinguish between them. These types of distinctions are commonly found along industrial lines.

The hierarchy shown in table 1 begins by classifying occupations into one of three basic skill type categories—information, services, and goods—and then divides them further into one of three skill levels. Note, however, that this order of classification could have been easily reversed. For instance, all occupations of skill level I could have been grouped together first, and then divided into three skill-type categories.

The order in which the occupational data are aggregated can be based on the hiring practices of employers. It is often suggested, for example, that small firms have different expectations about their employees than large firms. One interpretation of that statement is that small firms require their employees to perform across more than one skill level or skill type. A doctor who also performs nursing duties is an example of someone functioning across skill levels, whereas a chef who owns

and manages a restaurant is combining skill types. If it is the case that small firms want their employees to function across more than one skill level, but within the same skill type, table 1 can be adapted to that possibility by collapsing the classification scheme across skill levels. Similarly, if firms hire according to skill level, but expect versatility across skill types, table 1 could be suitably rearranged by first organizing the data by skill level. However, the classification in table 1 requires further adaptation to allow for the possibility that employee functions may include a combination of different skill levels and types. In that case, it may be necessary to resort to a system of primary and secondary activities based on time allocation. That would be necessary, for example, in the case of a restaurant owner-manager (information occupation, level I) who also waits on tables (service occupation, level III.)

In summary, the occupational classification shown in table 1 is a three-dimensional classification. The three classifying variables are skill level, skill type, and type of work. Figure 1 displays a graphical representation of these notions. In figure 1, the vertical axis represents skill level and the horizontal axis represents skill type. The third dimension—type of work—is represented by the axis labeled industry since industry is often synonymous with type of work. The intersection of service occupations and the transportation industry yields a three-tier column representing three skill levels. This column is differentiated from another set of service occupations—health services—due to differences in the type of work. Since in-person health services require a minimum of skill level II, the intersection of services and the health-care industry yields only a two-tier column. With regard to information occupations, the boxes marked "II" represent supervisory occupations within the two industries. Boxes at a higher level could be used to represent managerial occupations, and those at a lower level could be used to represent secretarial occupations.

The interaction between skill level and occupational detail is shown in figure 2. The focus in that figure is on transportation occupations. As shown in figure 2, airplane pilots need a higher level of skill than train (locomotive) engineers who, in turn, are required to possess a higher level of skill than taxi drivers. Thus, while these three occupations are similar with respect to skill type, they share no association with respect to skill level.

Case study

The case study shows how some detailed occupations taken from the DOT would be assigned a place in the "ideal" SOC framework as shown in table 1. The focus of the case study is on the assignment of skill levels and skill types to occupations; the assignment of industries is not considered. The occupations, suggested by BLS staff, are as follows:

DOT code	Title of occupation
141-137-010	Production manager, advertising
180-167-142	Manager, nursery
605-280-010	Milling-machine set-up operator I
605-685-030	Milling-machine tender
955-222-010	Instructor, wastewater-treatment plant

Complete description of these occupations, as given in the DOT, are shown in chart 1.

The first occupation, production manager, advertising, principally involves the coordination of commercial art activities and the supervision of workers. The occupation also includes the selection of arrangement and style of the commercial art. With regard to skill type, this occupation is clearly an information related activity. The objective of the occupation, or its output, is dissemination, collection, and review of information. With regard to skill level, this occupation is middle level. The occupation receives middle level ratings with respect to GED: ratings of three or four on scales of one to six. The same is true of the extent of specific vocational preparation, used here as a substitute for years of education and experience. The occupation requires middle to high levels of skills with respect to data and people, but only a low level of skills with respect to things. The preponderance of middle level skills means that this occupation is a level II information occupation.

The second occupation, manager, nursery, involves making decisions regarding the quantity and variety of plants to be grown based on the analysis of data concerning elements of nature, demand conditions, etc. The nursery manager also coordinates activities ranging from planting to marketing through a layer of subordinate supervisory personnel. These are all information related skills. However, the occupation also involves making choices with respect to seeding, fertilizing, and disease control. These are production or goods-related decisions. Thus, the skill type of this occupation could be either information or goods. Given that the occupation requires an intimate knowledge of the production process and includes activities directly related to production, this occupation, along with other farm-management occupations, should probably be classified as a goods occupation. An exact determination of primary and secondary activities would require further information on the allocation of time of a nursery manager. Regarding skill level, this occupation receives generally high ratings on the GED and SVP scale. It also receives a high rating with respect to data. Its low rating with respect to people appears to be an anomaly given that the occupation involves the coordination and supervision of activities.[15] In table 1, this occupation would be classified as a goods, level I, occupation.[16]

THE THREE DIMENSIONS OF THE "IDEAL" SOC

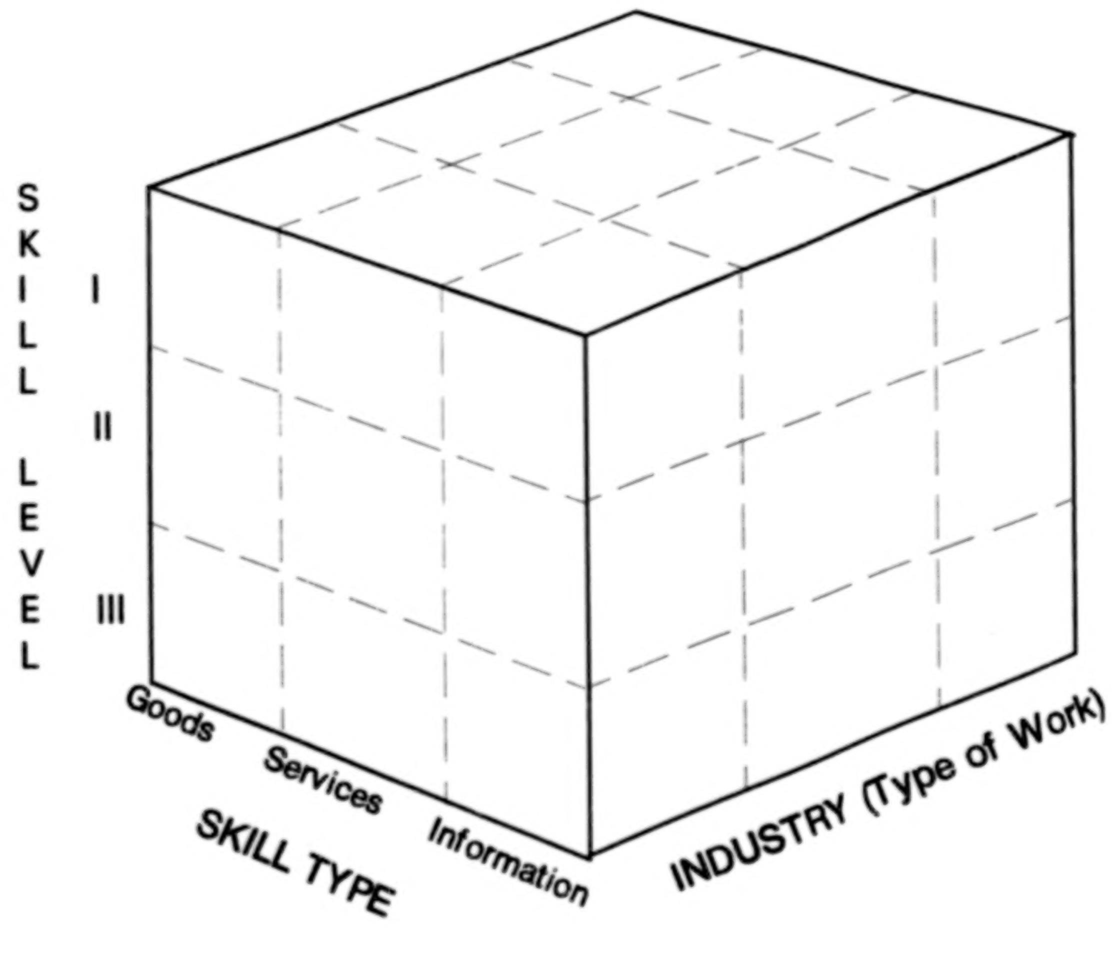
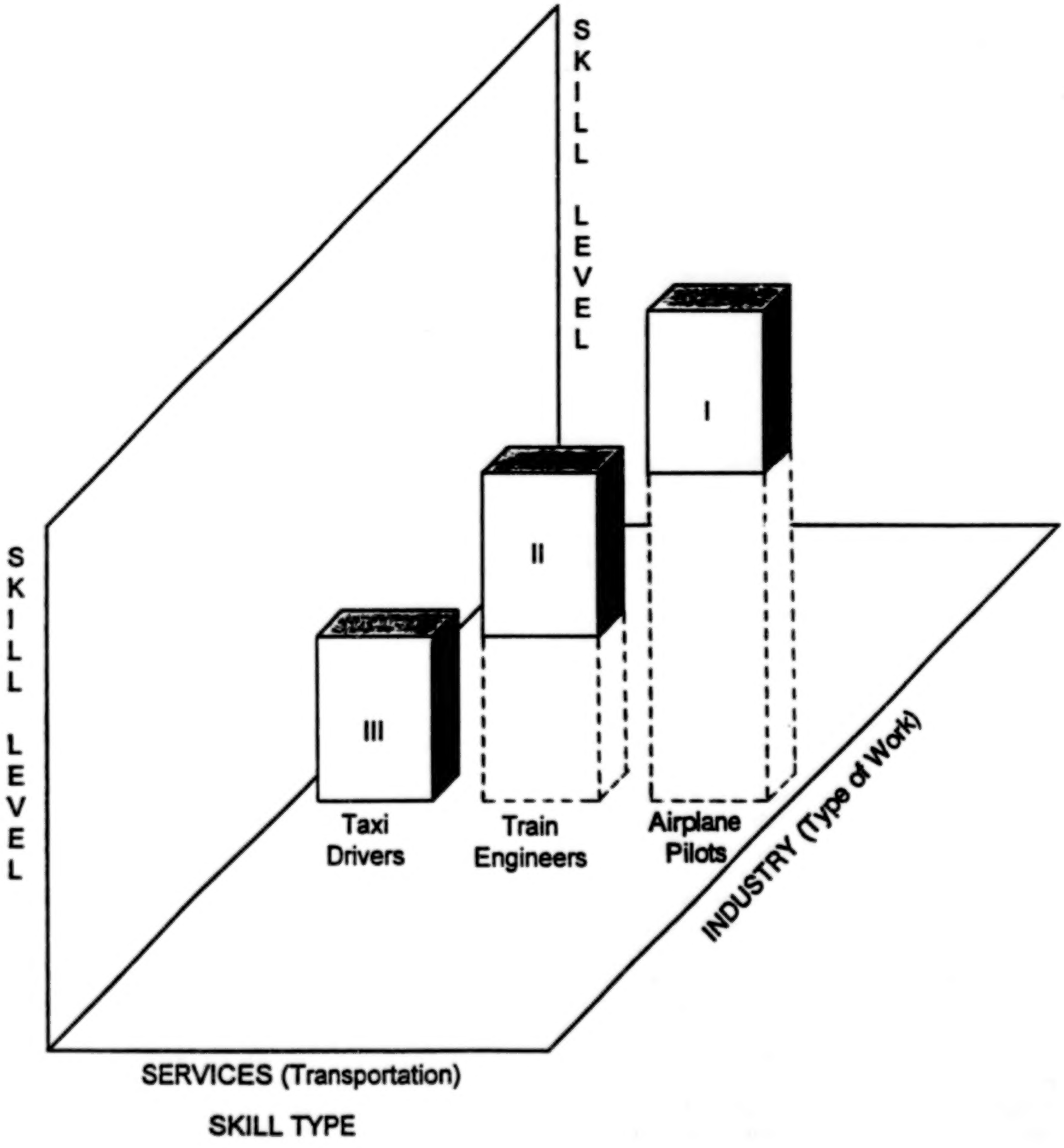


FIGURE 2: INTERACTION BETWEEN SKILL LEVEL AND OCCUPATIONAL DETAIL



The milling-machine set-up operator and milling-machine tender are examples of occupations that are of the same narrow skill type but are performed at different skill levels. An operator represents a natural order of progression for a tender. Because of the differences in skill level, the two should be retained as separate occupations. A milling-machine set-up operator is a goods, level II, occupation. The occupation does receive the highest rating with respect to the operation of things, but its ratings with respect to data and people range from the middle level to the lowest level. The GED and SVP ratings of the occupations are middle level. The occupation falls into the goods category because of its clear relationship to the manipulation and production of tangible things. A milling-machine tender shares some production-related duties with an operator. However, a tender's duties with respect to data are virtually nonexistent, and only low levels of skill are required with respect to people and things. Correspondingly, a milling-machine tender receives low ratings on the GED and SVP scale. Thus, this occupation is a goods, level III, occupation.

An instructor, wastewater-treatment plant, is clearly an information occupation. The occupation is about the dissemination of information, albeit with respect to the operation of things. The GED, SVP, and DPT of this occupation uniformly signal that this occupation uses middle-level skills. Thus, this occupation is an information, level II, occupation.

Implementation of the ideal SOC

This section discusses the possibilities of implementing the ideal SOC within the framework of current statistical data gathering activities. The precise form of implementation depends, of course, on the final form adopted for the ideal SOC and on the results of feasibility studies.

For the most part, implementation of a skills-based system is possible without the need for major revisions in statistical surveys. Skill levels were defined on the basis of principles already implemented to a large degree in the current DOT. Skill types are also discernible within the present DOT framework. In addition, the unit of observation is an occupation, not a person. The ideal SOC classifies occupations based on their requirements with respect to skills. These skills are required of workers, but they are imposed by employers. Thus, establishment surveys similar to the types already conducted, but with a new emphasis on occupational skills, would be sufficient to gather the required data. Household surveys would not be needed to implement the ideal SOC. In fact, skills-based establishment surveys are likely to suggest ways in which household surveys may be improved with regard to the gathering of data on human capital.

Perhaps the simplest form of implementation would be to revisit the issue of skills at the time of the next revision of the DOT. For example, data on years of education and labor market experience required by occupations may also be collected. It would also be desirable to ascertain the extent of substitutability between general education and specific vocational preparation in an occupation. Thought should be given to moving the GED and SVP data to a more prominent place in the occupational coding. One possibility is to collapse the DPT and GED ratings into one numeral each, instead of the present three. That would require the development of a weighting scheme that "adds up" the various components of DPT and GED into one number representative of the overall skill requirements of an occupation. The aggregative skill levels should differentiate no more than three or four classes of skills.

The advantage of summarizing the data on DPT and GED is that the middle three digits of a 9-digit DOT code could then be used to convey more information than is the case today. The fourth digit of the 9-digit DOT code would represent the DPT skill level, the fifth digit would stand for GED skills, and the sixth digit would represent educational requirements, including any specific vocational preparation. More detailed data on DPT, GED, and educational requirements could be placed in the definition trailer.

The discussion above is couched in terms of existing DOT terminology but is consistent with the recommendations of APDOT. APDOT has recommended that skill levels should be defined over a broader continuum of worker attributes than just DPT or GED. From the point of view of the ideal SOC, that type of detail represents a device for disaggregation. The need for aggregative representation of skill levels arises from the need to classify occupations.

The DPT concept deserves reconsideration for reasons other than just the APDOT recommendations. For example, instruction skills might be viewed more in light of their relationship to the dissemination of knowledge than by the nature of their relationship to people. The same might hold for "diverting" as a people skill.[17] The reason why instruction is viewed as a higher level skill than diverting is not clear. If they are to be ranked, it may be feasible to do so by appealing to the level of skill, or complexity, with which they are called upon to analyze and deliver information.

The DOT concepts of how individuals relate to things also need to be reevaluated. Currently, the DOT places strong emphasis on manual dexterity in the use of things. However, the manual skills used to operate the machinery and tools of the manufacturing economy are becoming less relevant in an increasingly information-based economy. The tools of an information economy are electronic, not mechanical. They are operated not with physical dexterity but with the writing of commands in coded languages. Computers, after all, are mere things, but the skills with which occupations or people relate to these things are not fully reflected in the DOT. Thus, it is the case that the DOT assigns computer scientists the

lowest possible level of skill with respect to things.[18] The need to reconsider the notion of skills with respect to things is also underlined by the penetration of electronics into the world of manufacturing. Robotics and computer aided design (CAD) and computer aided manufacturing (CAM) are examples of manufacturing processes where people relate to things in ways that are not manual.

The OES could be used as a vehicle for testing the feasibility of implementing a skills-based system of classification. For example, the OES could present a sample of employers with more information on skill levels assigned to occupations by the DOT. The OES could then elicit the opinion of employers regarding those assignments. That could prove to be of value in ascertaining how employers view the issue of skill levels. Alternatively, the OES could ask employers to assign their own skill-level ranking to occupations. Sufficient agreement across employers could be used as a guideline for assigning skill levels to occupations. A sample of employers may also be tested to determine the extent of information they can provide about their employees. Even if an employer reports that a particular job does not require a college degree, it may be the case that most employees in that job hold a college degree. That type of information may lead to a reevaluation of requirements for some occupations, in addition to substituting for some household survey type of information.

Conclusions

This paper has proposed an occupational classification system that is capable of serving as a successor to the SOC. The proposed system is based on the classification of occupations primarily by skill levels and types, but in a way that complements the type-of-work approach. Thus, the system represents the evolution, and not the replacement, of existing classifications. Skill level and type are defined in a way that are largely consistent with the current definitions in the DOT and the recommendations of APDOT. The type-of-work approach proves valuable with respect to the separation of occupations at lower levels of aggregation.

Because the proposed system classifies the characteristics of occupations, it can be implemented within current establishment-based data gathering frameworks. The highest level of aggregation in the current SOC consists of 20 occupations, not including military and miscellaneous occupations. The proposed SOC would consist of only nine 1-digit categories based on the combination of three skill levels and three skill types. But the proposed SOC preserves and enhances the current value of the SOC and DOT to their users. For example, while the traditional type-of-work function of the SOC and DOT would be retained, the proposed system also provides additional insights into the substitutability of skills across different types of work. That is a clear benefit to those who currently use the DOT for job matching. The proposed SOC would also reveal more about the human capital structure of the labor force and provide it in a more transparent fashion.

Notes

[1] These debates are part of a broader literature on recent changes in the wage structure in the U.S. labor market. See, for example, Katz (1993), Krueger (1991), and Bound and Johnson (1992).

[2] The three terms are used interchangeably in the National Occupational Classification of Canada.

[3] Of course, downwards mobility is always feasible.

[4] However, once skill levels have been assigned to occupations based on DPT, GED, and SVP, a multivariate regression analysis could serve as a useful means to test whether, holding all else constant, wages across occupations vary with their skill level requirements. A successful regression would provide evidence in support of the use of the DOT data to determine occupational skill levels.

[5] The debate over the relative "value" or "quality" of occupations can be avoided if skill level is taken to mean the relative performance of individual workers within an occupation. However, that would also make it impossible to ascertain either the human capital content of the work force or the human capital demands of the labor market.

[6] The extent to which individuals are over or under qualified for their jobs is not fully known. There is evidence that about 20 percent of college graduates are working in occupations that do not generally require a college degree (Hecker, 1992). This level of "mismatching" is expected to last into the future (Shelley, 1992). However, it is also the case that regardless of occupation and age group, college graduates earn more than noncollege graduates (Levy and Murnane, 1992). In other words, even if some occupations may not, on paper, require a college degree, they appear to reward the workers who do possess one. There would be no such reward if the college degree were truly irrelevant. Part of the problem with the findings concerning mismatches is that they are based on occupational classifications that currently do not provide direct information on human capital requirements. A more detailed job analysis, much like the DOT, is necessary to determine true occupational requirements and the extent to which the workers in those occupations are misplaced into those occupations.

[7] Whether or not two regressions have the same structure is determined by a statistical test (the Chow test) that tests for equality between sets of coefficients across regressions. A finding of similar structure means that,

instead of running two wage regressions, the data for the two sets of workers may be pooled into one regression because the workers belong to the same population (occupation).

[8] This is also a drawback of the supply-side approach.

[9] Of course, this does not mean that the workers filling these jobs are necessarily identical. In disequilibrium, i.e. when workers and the jobs they fill are mismatched, personal attributes are not necessarily the same thing as the requirements of jobs with respect to those attributes. This raises the possibility that a grouping of workers based on their supply of human capital attributes could lead to yet another set of conclusions.

[10] The NOC emphasizes that skill level groupings are indicative only of actual occupational requirements, and not of any socioeconomic status.

[11] It should be noted here that while the DOT provides most of the ingredients necessary to ascertain skill levels, the DOT system is not meant to classify either jobs or people by skill level. Instead the system is used to differentiate among already well defined, and detailed, job categories. That reflects the DOT emphasis on type of work performed. The DOT system is also outmoded in some respects. For example, the seven skill levels within the "things" category reveal an overwhelming emphasis on traditional, blue-collar manufacturing jobs. That emphasis is misplaced in an economy in which jobs are steadily shifting away from manufacturing and into services.

[12] An occupational classification that emphasizes skills would also be valuable to researchers attempting to determine the extent to which people are working in occupations for which they are under or over qualified.

[13] The distinction between skill type and type of work was noted earlier in the section.

[14] The exact meaning of these levels are described in the DOT handbooks. Note that with respect to DPT, the DOT uses low numbers to denote higher levels of skills, whereas with respect to GED and SVP the DOT uses high number to denote greater skill levels.

[15] It should be noted here that the DOT itself acknowledges that its ratings on the people scale are somewhat arbitrary.

[16] Another anomaly in the description of this occupation appears in the list of undefined related titles. One undefined related title is Manager, Retail Nursery. However, the duties of a retail nursery manager would appear to represent only a subset of the duties of a nursery manager. No decisions regarding the production of plants are required at the retail level. A retail nursery manager, lacking the connection to production, would most likely appear as an Information, Level II, worker in Table 1. The occupation is not designated a service occupation because it appears to lack direct contact with consumers in a significant manner.

[17] "Diverting" is classified as a people skill in the DOT. It is defined as the act of amusing others (usually accomplished through the medium of stage, screen, television, or radio.)

[18] Reflecting the DOT focus on manual dexterity, Computer Operators (DOT Code 213–362–010) receive a higher rating with respect to things than Computer Systems Engineers (DOT Code 033–167–010). To the DOT's credit, the latest edition includes a new two-digit division covering computer-related occupations. Robotics occupations also appear for the first time.

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Alternative Approaches to Classifying Occupations

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Introduction

Jobs differ on the basis of numerous attributes, and workers differ in their characteristics. Indeed, Welch and MaClennan (1976) suggest that ". . . if job content is defined as embracing what people do, their relation to others and what others do, and remuneration, both psychic and monetary, the logical conclusion is that no two people hold precisely the same job." (p. 1) For purposes of data collection and analysis involving occupations, a system or systems must be adopted which summarize this information in an efficient fashion.

This paper examines needs for occupational classification and properties of an ideal occupational classification system or systems designed to address these needs. We place particular emphasis on the needs of analytic users of the establishment and household surveys conducted by statistical agencies, recognizing that there are other uses and users.

At present, no single "official" classification system exists for occupations for the United States. The second section of this paper provides background on criteria in existing U.S. systems. Then, we discuss conceptual issues in grouping data on workers, focusing on the implications of economic theory. Next, we use CPS data on individual workers to investigate the importance of the Census occupational codes in explaining wages. More specifically, we aggregate 3-digit Census occupations in such a way as to ensure the minimal loss in variance of wages, and we examine the contribution of standard human capital variables as well as occupation in explaining wages. The next section examines various classification issues in light of the theoretical discussion and empirical results presented in the earlier sections. The final section concludes.

A brief summary of U.S. classification systems

Various Federal agencies promulgate a number of different occupational classification systems. The Office of Management and Budget issues the Standard Occupational Classification system (SOC) and the Bureau of the Census uses its own system for its population Census and household surveys. The Department of Labor itself developed three occupational approaches. The first of these, the *Dictionary of Occupational Titles* (DOT), is issued by the Employment and Training Administration, and the other two systems are used by the Occupational Employment Statistics survey (OES) and the Occupational Compensation Survey Program (OCSP) in the Bureau of Labor Statistics.

The DOT is not used for statistical data collection. Its original purpose was providing public, State, and local Employment Service offices with occupational information and the techniques for proper classification and placement of unemployed workers. The DOT is by far the most detailed occupational classification system, containing 12,741 distinct occupational classifications. Occupational analysts have estimated the various skill requirements placed on the worker in each of these occupations. Requirements are stated in terms of levels of a fixed set of skills. The various skill dimensions include educational development, the language and math skills required for the position, the amount of time required to develop the facility for average job performance, the strength and motor coordination required to perform the job, and the worker's responsibility for dealing with people and materials.

The SOC contains 664 distinct occupational categories and was last revised in 1980. The categories are for the most part aggregations of the more detailed DOT categories. The SOC was developed in order to establish "common definitions and classifications for use by Federal statistical agencies and other organizations." The primary organizing principle is that "an occupation should be classified on the basis of work performed." (*Standard Occupational Classification Manual*, 1977) Thus, skills, training, education, licenses, and credentials are not bases for classification. In addition, occupations are usually defined independently of work setting; large size is not a sufficient reason for separate identification of occupations and small size is not a sufficient reason for exclusion from separate identification; and supervisors are identified separately from other workers.

The Census and OES systems both take the SOC as a starting point and make changes that are deemed appropriate.[1] OES uses its system in an establishment survey that is used to develop national and state employment data for detailed occupation by industry. Surveys in which the Census codes are used include the monthly Current Population Survey (CPS), which is collected for the BLS.

The Census classification system contains approximately 500 distinct occupational classifications, while the OES system contains about 750. The SOC and the Census systems are similar in many respects although they differ in some ways that are noted below. Both classifications emphasize production-related occupations. About 41 percent of the Census categories and 48 percent of the OES categories are production-related occupations; these occupations contain only 28 percent of all workers in the 1989 CPS. Both classifications also contain a considerable number of managerial, professional, and technical jobs. About 31 percent and 28 percent of the Census and OES detailed occupations, respectively, are devoted to these occupations; however, in contrast to production-related occupations, this is roughly proportional to employment, as 28 percent of all workers in the 1989 CPS are employed in managerial, professional, and technical occupations.

The OES system emphasizes certain occupations viewed as being of special interest to data users, such as technology-related occupations and those which require special training. In addition, the OES classifications place somewhat greater weight on distinguishing between the functions performed in different jobs, while the Census system is more strongly oriented toward distinguishing between the industries in which different jobs are found. Thus, for example, the OES system distinguishes between "printing press machine setters and set-up operators" and "printing press machine operators and tenders," while the Census sytem groups both of these jobs under the classification "printing press operators." And the Census system distinguishes between "sales workers, motor vehicles and boats," "sales workers, apparel," "sales workers, shoes," "sales workers, furniture, and home furnishings," "sales workers, radio, television, high fidelity equipment, and appliances," and "sales workers, hardware, and building supplies," but the OES system places all these jobs under the classification, "salespersons, retail."

Finally, the Occupational Compensation Survey program also has its own classification system. Because OCSP is primarily concerned with comparing Federal Government pay to pay in the private sector, OCSP's classification system focuses on jobs actually found in the Government.[2] OCSP's classification system is quite detailed. In contrast to the DOT and SOC classifications, OCSP occupations frequently are divided into two or more work levels or "grades." For example, OCSP distinguishes between six different grades of accountants, each grade distinguished by a different level of overall responsibility and duties.

Conceptual approaches to classifying occupations

As has been recognized explicitly in ongoing work by the Economic Classification Policy Committee (ECPC) (1993), classification systems must be designed according to uses of the information they provide. Some time ago, Cain, Hansen, and Weisbrod (1967) (hereafter, C-H-W) noted that "Despite the potential importance of occupational data and the Government's interest in them, little effort has been made by academic economists to examine the conceptual basis of the occupational classification system or to suggest modifications in the light of their own objectives." This statement remains true today.

For purposes of analyzing labor markets, it is appealing to think in terms of conceptual approaches based on models of the demand for labor—how employers choose to use different types of labor—and the supply of labor—how individuals choose how much labor to supply and what jobs to enter. C-H-W took the position that ". . . occupational classification can serve economists as part of a larger information system, a system designed to reveal more about the current and prospective labor-resource flexibility of the economy," while recognizing that there may be other objectives as well. They stress that for the economist, occupational groupings should be relatively homogeneous in the sense that a high degree of substitutability should exist within each group compared to between groups. From the employer's standpoint, this depends on the technical production function (a demand-side approach); from the worker's side, this depends on workers' preferences along with their abilities to perform various tasks (a supply-side approach).[3] Below, we consider further the demand- and supply-side distinctions. We then discuss other, related criteria.

Demand-side considerations. Economists term the technological relationship between outputs and inputs a "production function." Given a production function together with product prices, wages of different types of labor, and prices of other inputs, firms will choose labor and other inputs so as to maximize profits or minimize costs. Thus, the demand for different types of labor—different occupations in this context—depends on wages, prices, and technology.

In the literature on consumer demand, one strain of work models demand not as demand for a good (such as an automobile), but rather as a demand for a bundle of characteristics (such as size, horsepower, and so on). Similarly, a way to think of what is going on in the demand for workers or occupations is that an occupation is really a bundle of worker characteristics that are needed to produce the product; see Welch (1969). These characteristics must be the skills that are needed for production.

Triplett (1990, p. 23) recommends grouping labor input data so that occupations can be employed in productivity studies, and recommends "functional aggregation" as the grouping criterion. Functional aggregation is a grouping method that depends on the structure of the production or cost function, specifically on certain "separability"

conditions. For instance, a particular type is weak separability of the production function, which would require that the marginal rate of substitution between two labor types within a group to be independent of quantities of any labor type outside that group. A special case would group occupations that are close substitutes in production.[4]

Another type of aggregation that has been considered on the product/industry side is Hicksian aggregation; see Triplett (1990) for additional discussion and references. The basis for this approach is Hicks' finding that if the prices of goods in a group all change by the same proportion, then these goods can be grouped together for the purpose of analyzing the demand for goods and services. Thus, for the purpose of studying the demand for workers, one could group together those occupations whose wage changes are the same (assuming that wages capture all the costs of employing labor).

In addition to its use for productivity studies, a classification scheme resulting from production-based aggregation would be important for analyzing a variety of issues pertaining to labor demand. For example, Hamermesh (1986, pp. 462–3) finds a generally inverse relationship between a groups' average skill (as measured by the production/nonproduction worker distinction or by education) and the elasticity of demand for its labor. This says that the percentage decline in the demand for more highly educated workers in response to a given percentage increase in their wages is less than the percentage decline in the demand for less educated workers in response to the same percent increase in their wages. Hamermesh also concludes (p. 467) that a fall in the price of capital services will cause employers to produce any given output level using more skilled labor. Groupings based on demand side factors may be of interest for uses besides analytic studies. For instance, information on what types of workers employers are looking for would be of interest to students or unemployed workers.

An attractive feature of a demand-based occupational classification system is that it would be logically consistent with a supply- (or production-) based industrial classification system. Combined with industry data on outputs, prices, and other inputs, wage and employment data from a demand-based occupational classification system would be ideally suited for analyses of productivity and economic growth. Note further that surveys that provide information on occupations typically provide information on industry as well. It would therefore be redundant to use industry as a classifying criterion in an occupational classification system. In fact, if a goal of occupational data is to provide information on skills transferability, then having occupations be defined so as to be specific to an industry is counterproductive.

Supply-side considerations. Occupational groupings would also appear to be valuable for analyzing questions pertaining to labor supply. As discussed by Rosen (1986), workers care about both their market consumption (income) and the consumption aspects of their job. When deciding between two jobs, a worker will choose that position offering the higher satisfaction or "utility." Thus, according to the theory of equalizing differences, less pleasant jobs will have to offer a compensating higher wage.[5] The literature on equalizing differences is replete with job attributes for which compensating wage differentials arise. Measurable job attributes for which significant differentials have been found (see Rosen's 1986 summary) include onerous working conditions, such as risks to life and health and exposure to pollution, and special work-time scheduling and related requirements, including shift work, inflexible work schedules, and possible risks of layoff and subsequent unemployment.[6] A supply-side approach would group occupations according to these attributes.[7]

A similar argument pertains to skills, at least those that workers can acquire on their own. An individual deciding on whether to become a doctor, a lawyer, a teacher, or a carpenter must compare the wages these occupations offer with the cost of obtaining the requisite skills. Individuals will be willing to enter occupations that require more training only if they offer a higher wage, all else equal. Equilibrium wage differences across occupations will thus reflect differences in training costs.

Other aggregation criteria. Firms' demand for workers (job types offered to the market) will depend on the nature of technology and individuals' work choices will depend on preferences, as described above. Market clearing wages will depend in turn on both supply and demand considerations.

Triplett (1990) has introduced the idea of "hedonic aggregation" for purposes of determining both industry and occupational groupings. This approach would use a statistical procedure to group individuals into occupations based on similarity of the hedonic function, a function which relates the price of a product or type of labor to its characteristics. While Triplett explicitly suggests an aggregation based on the productive characteristics of workers, a more general hedonic function based on all the market-clearing attributes could be used.

A major focus of labor economists and policy analysts is examination of the determinants of wages and earnings, particularly education and experience (or age). Wages and salaries are also the focus of the Federal pay-setting activities toward which certain of BLS's wage surveys have been targeted. The only previous empirical study of how occupations should be grouped of which we are aware, namely Welch and MaClennan (1976), groups on wages. We examine this approach in the next section, where we group Census detailed occupational categories

so as to minimize the loss in wage variance across groups. Because wages are determined by the interaction of supply and demand, this approach automatically takes into account both demand- and supply-side factors.

Grouping occupations: an empirical study

In this section, we present results of an empirical study examining the extent to which variations in wages can be explained by detailed occupational codes and how much of this explanatory power remains after aggregating the three-digit occupations into broader categories. This empirical analysis, which uses CPS data, illustrates how the researcher can aggregate these classifications into broader groupings suitable for his particular purpose. Rather than grouping specifically on demand- or supply-side criteria, the aggregation scheme discussed below is based on market outcomes. Specifically, occupations are grouped together if they offer a similar wage and apart if they offer dissimilar wages; it makes no difference whether these wage similarities and differences are caused by demand or supply factors. We show that if one's purpose is to analyze wages, then broad aggregation, if done appropriately, can preserve most of the information in the detailed codes.

It must be pointed out that there are problems with occupational coding in household surveys, and these variables may contain considerable noise. While establishment surveys provide better measures of occupation, they do not provide information on wages by detailed occupation for all occupations and industries. In addition, establishment data do not contain the human capital measures on which we also focus.

Clusters on wages. Welch and MaClennan (1976) found that much of the detail contained in the Census occupational codes was irrelevant in terms of two attributes of jobs: wages and socioeconomic status. They used the 1 in 100 Public Use Samples of the 1960 and 1970 Censuses to analyze how much wage information is actually contained in the 3-digit 1970 Census occupation codes. They found that wage differences across 3-digit occupations account for approximately 25 percent of the variation in wages in the Censuses and that aggregating to only nine titles preserves about 98 percent of this variance. Because the occupational codes have changed and because there may have been important changes in the wage structure in recent years, it is informative to repeat this exercise using more recent data.

To guard against picking up any possible anomalies due to the recent recession, we have chosen to analyze wage data for the year 1989. As already noted, the source of our data is the CPS.[8] The subsample used in our analysis was obtained as follows. Each month those individuals in the outgoing CPS sample rotations who were employed in a job the week prior to the survey are asked the hours they usually work in the job and the weekly earnings they usually earn in the job. We will refer to this subsample of employed individuals as a "quarter sample" because each month one-fourth of the individuals in the CPS are in the outgoing rotations. Because of the way the CPS sample is constructed, no individual can be in the quarter sample twice in a calendar year.[9] One can thus obtain a representative sample of workers for 1989 by merging the quarter samples for all months. As each quarter sample contains approximately 13,250 workers, the resulting sample would be very large. We have therefore randomly chosen 30 percent of the observations in each quarter sample, giving us a total sample consisting of 53,136 workers. We calculated these workers' average hourly wages by dividing their usual weekly earnings by their usual weekly hours.

After dropping individuals whose imputed wage is implausible, we are left with a sample consisting of 53,023 observations.[10] It is informative to look at the distribution of observations across the 503 occupations.[11] Welch and MaClennan showed that the distribution of observations across occupations was very uneven in the 1960 and 1970 Censuses. The same thing is true for the 1989 CPS: there are a few large occupations and the remaining occupations contain only a small number of observations. Specifically, there are 21 occupational categories that each contain 1 percent or more of the entire sample and the largest occupational code, "managers and administrators, n.e.c.," contains 5.3 percent of all the workers in the sample. The 40 largest occupational codes together account for 50.3 percent of the workers in the sample. In contrast, there are 349 occupations that individually contain 0.1 percent or less of the sample and combined contain 15 percent of the workers in the sample. Ten of the occupational categories are completely empty.

When we estimate an ordinary least squares equation in which the wage rate is the dependent variable and the only explanatory variables are 3-digit occupation dummies, we obtain an R^2 of .33. In other words, about 33 percent of the variance in wages in our sample can be explained by wage differences across 3-digit occupations. The remaining two-thirds of the wage variance occurs within occupations. The fact that most of the variation in wages occurs within rather than across occupations might seem to suggest that if we are interested in explaining wages, we might perhaps do better with some other occupational classification system. Still, it is important to realize that .33 is not a low R^2, particularly, when one considers that we are dealing with a cross section, that we have made no attempt to control for variables such as labor market experience, and that survey errors alone will cause wages to vary across individuals in our sample. All things considered, the 3-digit occupational codes appear to "explain" a substantial amount of the variation in wages. This is more impressive when one takes into account that the occupations are coded with considerable error.[12]

When we replace the 3-digit occupation dummies in the wage regression with the 46 2-digit Census occupation dummies, we obtain an R^2 of .28. And when we instead use the 14 1-digit Census occupation dummies, we get an R^2 equal to .21. Thus, while aggregation to the broader 2-digit and 1-digit occupational codes preserves much of the wage information that is in the 3-digit codes, a substantial amount of information is lost, particularly when one goes to the 1-digit categories. It is natural to ask whether we can find an aggregation scheme that preserves more wage information. And if so, whether we can glean any principles as to how occupations should be classified in the first place.

The aggregation procedure we adopt is similar to Welch and MaClennan's and is known as Ward's method. Ward's method is a hierarchical agglomerative procedure that is designed to maximize the variance across clusters. The procedure works as follows. Initially, we start with 493 distinct clusters, where each cluster is defined by a 3-digit occupational code and is assigned a wage equal to the mean wage of all individuals in the occupation.[13] Next we consider all possible ways of combining two of the occupations into the same cluster. Note that there are many different combinations (492 factorial). We choose that combination that maximizes the variance of wages across clusters (or, equivalently, minimizes the variance of wages within clusters). This completes the first stage in the aggregation procedure. At the end of this stage, we have reduced the number of clusters by one.

The next stage repeats the process. The procedure continues by steps until we have combined all the occupations into two clusters. We may note that the procedure is not fully efficient because once we have joined two clusters we do not allow them to be untied at some future stage. However, from our results it will be clear that this restriction is not very serious.[14] One other general feature of the aggregation procedure is worth noting. The procedure tends to join clusters with small numbers of observations and to produce clusters with roughly the same number of observations; we will return to this point below.

The results of applying the aggregation procedure to the CPS data are summarized in table 1, which reports the R^2 from the wage-rate equation using various sized clusters. Our aggregation clearly does a much better job of preserving wage information than does the Census aggregation to 2-digit and 1-digit occupations. The results are quite striking. Ninety-nine percent of the variance explained by all the 3-digit occupational codes is preserved after aggregation to 14 clusters. Aggregation to 10 groups retains 98 percent of the variance and aggregation to 5 groups preserves 94 percent of the initial variance. In fact, 70 percent of the initial wage variance across 3-digit occupations is preserved when we aggregate to only two occupational groups. These results are very similar to Welch and MaClennan's using the 1960 and 1970 Census data.

Clearly then, broad aggregation preserves most of the wage information in the detailed occupation codes. One reason for this is the uneven distribution of observations across occupations. An occupational code containing only a few observations is not likely to provide much information about wages (or anything else for that matter). Welch and MaClennan (p. 6) refer to this uneven distribution when they note that "the 'worm's eye view' problem in naming occupations is perhaps best exemplified by noting that truck drivers represent 4.0 percent of our sample and are not differentiated, while there are at least 15 detailed codes for professors, who in combination account for less than 1 percent of the sample."[15]

Table 2 summarizes the occupational groupings that result when we aggregate to 10 clusters. For reference purposes, we have attempted to provide summary names for each of the 10 clusters. The lower and higher wage clusters are easier to describe than are the middle clusters. The lowest wage cluster ("low service and low sales") is comprised of certain service workers ("low service") and apparel and shoe sales workers. The top two clusters are comprised almost entirely of lawyers, engineers, medical scientists, and pilots. Seventy percent of precision production workers are found in the middle clusters ("precision production, crafts, and high sales" and "precision production, foremen, and low professional"). Different types of sales workers are quite different in terms of earning power, being mostly found in the lowest two clusters (42 percent) or the middle two clusters. The five largest 3-digit occupations comprising each cluster are listed in table 3.[16] The most striking feature of table 2 is the strong positive relation between education and wages; higher paying occupations clearly have higher average education levels. In fact, the relation is nearly perfect: the educational rankings of the different occupational groupings correspond nearly exactly to their wage rankings.

The next thing to note from table 2 is that the high-wage, high-education occupational clusters are much smaller than the low-wage, low-education clusters. The highest wage occupational cluster ("medical, scientists, judges, and pilots"), is the smallest cluster in the sample, containing only 126 observations, .23 percent of the total sample. The occupational cluster with the second highest wage ("engineers, lawyers, and other professional") is the second smallest cluster, containing 521 observations, .98 percent of the sample. The third highest wage occupational cluster ("marketing, financial, and professors") contains 2,413 observations, 4.5 percent of the sample. Thus, in spite of the fact that the Ward method has a built-in tendency to produce similar sized clusters, the three highest wage occupations account for only 5.48 percent of the entire sample, while the three lowest wage occupations account for 51 percent of the sample. This

is largely due to the fact that the wage distribution is skewed rightward. Nevertheless, it illustrates the point that for some purposes it is not necessarily desirable to have equal sized occupational groupings. If one wants to maximize wage variation across occupational codes, then the high-skilled, high-education, high-wage groupings will contain fewer workers than the lower skilled groupings—simply because there are fewer workers in the high skilled, high wage positions.

Clusters on log wages and the effect of human capital. Given that high wage jobs tend to be populated by individuals with high education and low wage jobs tend to be filled by individuals with low education, it is quite possible that all the wage variation across occupational codes is caused nearly entirely by differences in education among occupations. We can examine this question, by adding education to the simple wage regression. In addition to education, we will also include other standard human capital indicators in the equation. This will enable us to ascertain what extra information occupation provides that one does not already have from the standard human capital variables.

When estimating wage equations, economists have found that they typically obtain better results when they use the log wage as the dependent variable. We will therefore follow the tradition of using log wage as the dependent variable. To isolate the effects of the change in functional form, we start by replicating our earlier analysis of variance, replacing the simple wage by the log wage.

As table 1 shows, when we estimate an equation in which the log wage is the dependent variable and the 3-digit occupational dummies are the only explanatory variables, we obtain an R^2 equal to .406, indicating that the 3-digit occupational dummies explain about 41 percent of the variance in log wages. Note that the R^2 for the log wage equation even exceeds that in the wage equation. Thus, the 3-digit occupational codes clearly contain a lot of information, whether one is interested in wages or log wages. As was true with the wage information, aggregation into broader clusters preserves most of the information on log wages provided that the aggregation is done effficiently. For example, aggregation to 10 clusters preserves 98.3 percent of the initial wage variation across occupations and aggregation to 5 clusters perserves 92.6 percent of the initial wage variation across occupations.

Table 2 summarizes the groupings that result when we aggregate to 10 clusters. Examination of table 2 indicates that the clusters are different in a key respect from those we obtained when we aggregated so as to maximize the variation in wages across clusters.[17] Specifically, the high-wage groupings include a higher fraction of the sample when we aggregate so as to maximize the variation in log wages across clusters. The explanation for this is straightforward. Because the log wage transformation compresses the high end of the wage distribution, wage differences among high-paying jobs are given less weight than wage differences among low-paying jobs. This has an important implication, namely, that the aggregation that is desirable depends crucially on the question at hand. The inappropriate aggregation can potentially lead to a significant loss of information. In the present case, our original aggregation loses twice as much information about log wages as the efficient one. However, the actual magnitude of this loss is small because, as discussed above, very broad aggregation (to as few as four or five clusters) still preserves nearly all the information. In other instances, the loss from inappropriate aggegation may well be much bigger.

As was the case when we clustered on wages, when we cluster on log wages we find that occupational groupings with higher log wages are characterized by higher education. In fact, the educational rankings of the different occupational groupings correspond exactly to their wage rankings. In this connection, it is worth noting that establishment surveys typically do not have much, if any, information on worker characteristics. Given the close connection between an individual's education and his occupation, information on occupation alone will tell the researcher a great deal about workers' education.

As discussed above, in light of the correlation between education and occupation, it is of interest to see how much wage information is contained in education and the other human capital variables if one does not control for occupation. The results of running a regression with education and other human capital indicators are presented in column 1 of table 4. Note that the equation includes dummy indicators showing whether the individual has only a high school degree, has attended college but does not have a bachelors degree, has a bachelors degree, or has education beyond the bachelors (the omitted variable is no high school degree). As expected, the coefficients on the education dummies all have a positive sign and indicate that the greater is an individual's education, the greater is his expected log wage. Also included in the wage equation are the variables age, which largely serves as a proxy for labor market experience, and age squared. The positive coefficient on age and the negative coefficient on age squared indicates that log wages increase at a diminishing rate with age. Finally, we have included dummy variables indicating whether or not the individual is male and whether he is white or black (the omitted race category includes Hispanics, Asians, and "others").[18] The regression coefficients confirm the usual finding that controlling for age and education, men earn more than women and whites earn more than blacks and others. For our purposes, the most useful statistic is the R^2, which is equal to .369, indicating that without the occupation dummies, the human capital

indicators account for about 37 percent of the variance in log wages.

Our results indicate that the 3-digit occupational codes by themselves explain about 41 percent of the variance in log wages, while the human capital indicators by themselves explain about 37 percent of the variance in log wages. If the 3-digit occupational dummies and the human capital indicators were completely uncorrelated, then including them both in the log wage equation would yield an R^2 of .88. Of course, our clustering results above indicate that education is highly correlated with 3-digit occupation. We should therefore expect an R^2 considerably less than .88 when we include both the occupational dummies and the human capital indicators in the same equation.

The results of including both the 3-digit occupation dummies and the human capital indicators in the log wage equation are shown in column 2 of table 4. The estimated equation has an R^2 of .508, indicating that together the human capital indicators and occupational codes explain about half of the variation in log wages. Thus, as expected, much of the wage information in the occupational codes is also contained in the human capital indicators, as indicated by the fact that the R^2 in the complete equation is less than .88. Still, the occupational codes do contain a significant amount of wage information that is not contained in the human capital indicators. Specifically, adding the occupational dummies to the log wage equation enables us to explain an additional 14 percent of variance in log wages (as indicated by the increase in the R^2 from .369 to .508).[19]

As expected, introducing the occupational dummies into the wage equation has a strong effect on the education coefficients. In fact, these coefficients are nearly cut in half. For example, the coefficient on the college degree dummy falls from .550 to .282. Thus, controlling for occupation, a college degree raises an individual's log wage by .282 (where the comparison is with what the individual would earn if he did not graduate from high school). In interpreting this result, keep in mind that .282 is clearly not the total return the average individual can expect from the degree because the degree grants the individual entry into higher paying occupations. Taking this effect into account, the total expected increase in log wages from the college degree is .550, the coefficient in the wage equation that does not contain occupational dummies. However, note that the .550 figure is only the average return to the college degree. Individuals who acquire different types of skills in college will earn different wages. For example, someone majoring in engineering might expect to earn more than than someone majoring in English. The occupational information can enable the researcher to determine the returns to the different fields. This information can be particularly valuable if, as in the present case, the researcher does not have information on the individual's actual major.

In light of the information possessed by the occupational codes, it is reasonable to ask why researchers using household data have not made more use of the occupational dummies. One reason may be that it is not a priori clear how to interpret occupational effects because occupations are not explicitly linked to skills or job attributes.

Another more subtle reason that occupational coefficients are hard to interpret and draw policy conclusions from involves the problem of "self-selection." Individuals are not randomly assigned to occupations, but make decisions about occupations on the basis of their skills and preferences. Engineers can be expected to have different innate abilities than individuals in, say, marketing, and carpenters will have different abilities than painters. Thus, occupational wage coefficients will pick up both returns to particular skills and self-selection effects. Note, however, that the same thing is true of educational wage coefficients. In fact, there has been considerable debate among economists as to whether the positive effect of education on wages is due to the fact that education actually imparts skills that are valuable in the job market or whether it simply reflects the fact that education serves as an ability signal.

Finally, we conclude the empirical analysis by adding 22 industry dummies and a dummy variable indicating whether or not the individual is a union member to the log wage equation. Interestingly, adding these variables only raises the R^2 to .538. Thus, somewhat surprisingly, the industry dummies contain little information that is not already in the human capital indicators and occupational codes.[20]

We close this section by noting a topic for further empirical work. The empirical analysis above demonstrates that the occupational codes contain quite a bit of wage information that is not contained in the standard human capital variables. In light of the discussion in the preceding section, the explanation for this would seem to be that when we add occupational dummies to a wage equation that already contains human capital indicators, we are controlling for unspecified skill and job attribute differences across occupations. The logical question to ask is whether this is picked up in the DOT information on job skills and attributes.[21] If the DOT information on job skills and attributes is accurate, then it should be able to explain much of the occupational wage differences.

Alternative classification systems

Our theoretical discussion and empirical analysis have some clear implications for classification systems.

Purpose of groupings. An important implication of the preceding discussion is that the occupational grouping appropriate for analytic studies will depend crucially on the question at hand. A grouping that is appropriate for analyzing demand-side considerations will be inappropri-

ate for analyzing supply side considerations, and vice versa. Detailed classifications that may seem unnecessary from one perspective may be necessary from another. For instance, consider "school bus drivers" and "other bus drivers." From the employer's side, these two occupations involve very similar technology—the worker drives a large vehicle through a wide variety of traffic situations. But from the worker's side, these two occupations have very different attributes. Specifically, the number and timing of hours of work for school bus drivers will differ from other bus drivers, particularly long-distance bus drivers. Two alternative classification systems are one possibility. (The possibility of having two systems for industry classification has been pointed out in ECPC issues paper #1 and elsewhere.) But since many uses of occupational data focus on market outcomes, a system meeting both needs simultaneously may be desirable. A scheme that can accommodate *both* demand and supply side uses requires more detail than a system that can accommodate only one. This detail entails two types of costs. First, and most obvious, is the cost in terms of resources. Second, the more detailed the system, the greater will be the number of classification errors that occur in practice.

In theory, current SOC-based classification systems are based on type of work, but, as discussed below, in practice, occupational classifications appear related to skill and work setting (and perhaps other factors), making them amalgams of both the demand- and supply-based approaches. In contrast to a system satisfying *both* demand- and supply-side criteria, a system that is a mixture of multiple approaches may not be well-suited to a particular use, such as analyzing demand.

Skills. Does the foregoing discussion imply that skills are a critical feature of a classification system motivated by economic theory? C-H-W explicitly did not attempt to determine which features and characteristics of jobs should be standardized, but they did find the use of skill attributes to be "intriguing." For major policy needs, too, the skills dimension seems critical. Assessment of labor market opportunities facing individuals, the need for various types of training programs, and so forth could not proceed using data which provide no skills measures.

Both the demand-side and supply-side arguments above motivate attention to some measure of skills in a classification system. The demand-side arguments focus on production relationships which might seem to suggest that one should view the function that a worker carries out as the critical dimension of a job. But the ability of a worker to serve a particular function depends on certain specific productive skills—the ability to serve some functions in a law firm depends on being a lawyer, the ability to work in some jobs depends on the ability to do heavy lifting, sales jobs require person-to-person skills, and so forth. In contrast, seemingly very different functions could require identical skills; for example, a manufacturing firm may have a number of jobs that do different functions, but for which very little specific training is required and do not differ in terms of, say, years of education, computer skills, motor coordination, etc. The workers in these positions will have similar skills and be nearly interchangeable. Demand-side and supply-side arguments would thus justify their being grouped together.[22]

The U.S. economy has been undergoing rapid changes in recent years, and these changes have affected the demands for workers in various occupations. (See Levy and Murnane for a detailed review of research on changes in the wage distribution and what is known about the causes. See Reich (1991) for a discussion of changes in the global economy that have affected U.S. workers.) A classification system defining occupations in terms of required skills and job attributes would be far better suited for use in a changing economy than one based on narrow distinctions in work performed that are not associated with significantly different skills. The latter system would be difficult to use as some jobs disappear and workers need information on what jobs are available and what skills are required to obtain these jobs.

A focus on skills seems in general accord with points made by Reich (1991). Reich is highly critical of government occupational classifications and suggests that for assessing issues relating to the global economy, jobs can be grouped into three broad categories: Routine production services, in-person services, and symbolic-analytic services.[23] Routine production workers and in-person service workers differ most in terms of their "people skills," since the latter provide services directly to the final consumer. Symbolic analysts are creative and have problem-solving skills. Distinguishing workers on the basis of these criteria would seem to require that the occupational classification system pay more attention to skills from the outset. It would also seem to require that more detail be devoted to high skill than low skill occupations.

By skills, economists typically mean human capital, as generally measured by education and experience (or age as the usual proxy for experience), and sometimes also by some measure of "ability" and/or training. This is not to say that economists would rule out the importance of the many other skill dimensions found in, say, the DOT. These other skill variables have not received much attention partly because they cannot be observed directly in household surveys or be measured easily in establishment surveys. Yet, to the extent occupational classifications that can be measured incorporate these dimensions, including occupational variables in analytic studies will capture them.

The SOC, and correspondingly the OES and Census classification systems, are intended to be based on the

type of work performed. Human capital variables, especially education and experience, are measures of skills; evidence for this is provided by the significant effects that these variables have on wages (even after controlling for occupation). Yet we find that the Census groupings that retain most of the variance in wages are very closely associated with education. This seems to say that the functionally-based occupational categories are closely related to skills. Further, we have argued that many functions are dependent on workers having certain types of skills. The importance of the occupational dummies in the wage equation demonstrates that the occupational codes are picking up some specific skills—the significant occupation dummies are largely picking up the fact that occupations that require similar amounts of schooling but involve different "fields" will offer different wages.

The empirical analysis of CPS data reveals that even though human capital variables, including a proxy for experience, and occupational dummies explain a great deal of the variance in wages, there is considerable variation within the detailed Census occupational categories. This is partly because skill level will vary among workers with the same type of skill and experience level.[24] For the most part, our discussion of skills has focused on skill type, such as the distinction between being an engineer or a social worker, not on the level or amount of skill that is required for the job or possessed by the individual. Firms choose to employ and utilize workers with varying skill or "work" levels; for example, they may hire electrical engineers of varying skill level. Thus, we would expect to observe considerable wage variation within narrowly-defined occupations if skill levels matter.[25]

Size of groupings and aggregation criteria. Another immediate implication of both the demand-based and the supply-based approaches is that size is not a classification criterion. C-H-W illustrate this with respect to sales workers and professors. Even though there are far fewer professors than sales workers, we may still want more detailed occupational classifications for professors than for sales workers. The substitutability between, say, sales workers, apparel, and sales workers, shoes, is far greater than that between college professors of economics and those in English. This is so because the amount of additional education/training for a professor to switch from English to economics is much greater than that required for a sales worker to switch from shoes to apparel. Regardless of whether the employer or the employee was responsible for the training, the switch from the English to the economics department (or vice versa) would be very costly, and even though some aspects of the jobs are the same, the individual's preferences and various skills with respect to the different fields could make this a quite difficult change. In other cases, it might be another type of skill, one not easily provided by formal education or training, that is at issue. For instance, we may want to distinguish between sales engineers and other engineers because they require different "people" skills, somehow defined. Similarly, we may want to distinguish between securities and financial services sales and financial analysts.

At the same time, there is little point in a classification system defining an occupation so small in size that reliable estimates of the wage or other charactistics cannot be obtained in any survey in which it is employed. There thus arises the question of how English professors and economics professors should be placed into more aggregative groupings if there are not enough classifications to keep them separate. Which skill type should be emphasized—knowledge of economics or English or the ability to teach? From the viewpoint of skill transferability, clearly an economics professor is much more able to move to an economic research job in a consulting firm than to a job as an English professor. From the demand side, economics professors and economic consultants are thus more substitutable than are economics and English professors. From the supply side, the aggregation criterion is less clear; a job as an economics professor has some attributes in common with a job as an English professor and some attributes in common with a job as an economics consultant, but an economics professor can more easily become a researcher in a consulting firm than an English professor.

Needs for household versus establishment surveys. Studies addressing labor supply issues and wage determination typically use household data sources such as the CPS. In contrast to the human capital variables, education and experience, these studies frequently do not use the occupational groupings. But our analysis shows they do matter. One reason the occupational information is sometimes not used may be that it is hard to interpret and draw policy conclusions from occupational effects because occupations are not explicitly tied to skills and job attributes. (As discussed above, self-selection is a second factor making interpretation difficult.)

Should the occupational classification system employed in a particular survey depend on the other data that survey provides? For instance, the skills based approach may give particular emphasis to the extent of education and experience required for a job, but household surveys already provide this data, so this type of detail would provide little additional information. In contrast, establishment surveys seldom provide information on the characteristics of workers, so if it is to be captured at all, skills based information must be incorporated into the occupational classification structure.

Put another way, in household surveys we can group directly on one set of skill variables, education and experience. It is typically not possible to do this in establishment surveys, and SOC-type classifications do not permit

it exactly (although, as we have seen, the clusters of SOC-based classifications are strongly associated with education). But it would be possible to develop a system whose occupational classification would correspond more closely to formal education and training requirements. For household surveys, occupational categories interpretable on dimensions other than education and experience would be of interest, for instance, skill types such as dealing with people.

As noted above, attributes of jobs that affect supply and hence wages should not be ignored for some purposes: unpleasant working conditions, shift work, erratic hours, and so forth. It should be possible to collect information on occupations defined on these attributes in both establishment and household surveys.

In household surveys, it is difficult to distinguish accurately between some occupations that require a similar type but different level of skill, for example, R.N. versus L.P.N. versus nursing aide. It would be even more difficult to code occupations according to work level within them (such as six grades of accountants). But in establishment surveys it is possible (although more costly) to obtain information on work levels within an occupation.

This discussion does not imply that it would be desirable to have separate classification systems for household and establishment surveys. Rather, it implies that if a goal is to have a system or systems that are used for both, it may be desirable for some purposes or even necessary in some cases to collapse (aggregate) categories differently in different surveys.

Conclusions

Our empirical analysis demonstrates that the 3-digit Census occupations contain quite a bit of information on wages. But it also makes clear that this information can be preserved at a much broader level of aggregation. However, one should not simply use the aggregate 1- and 2-digit Census codes—our aggregation scheme does a much better job of preserving information. Further, our results do not imply that the detail is unnecessary, because our aggregate categories may not be adequate for other purposes. Rather they indicate that empirical analyses can be improved if users develop their own aggregation schemes appropriate to their own purposes.

Although the success of the Census codes in explaining market wages suggests that demand and/or supply factors are already captured to a considerable extent in the existing codes, a revised system or systems based on fundamental economic principles would be more suitable for economic analysis. Our discussion indicates that a demand-based classification system motivated by economic theory would differentiate among occupations on the basis of their function, which is closely related to productive skills. A supply-based system would differentiate among occupations based on job attributes, including skills that are costly to acquire. From the research economist's point of view, we are unable to justify a system that makes detailed distinctions between occupations that require similar skills and have similar job attributes. Because demand- and supply-side substitution is much easier and less costly across low-skill jobs than across high-skill jobs, economic theory suggests that more detail is required across high-skill occupations than across low-skill occupations. A revised classification system based on fundamental economic principles would not only be more suitable for economic analysis, but would be more useful for other purposes as well.

Notes

[1] Although the Census and OES systems now take the SOC as a starting point, the original Census and OES systems actually preceded the SOC.

[2] OCSP is a program in the Office of Compensation and Working Conditions (OCWC). OCWC is also responsible for obtaining the Employment Cost Index (ECI). The ECI uses the Census occcupational classification system.

[3] Recently, beginning with Triplett (1990)—also see the papers in Department of Commerce (1991) and the ECPC Issues Paper No. 1—considerable attention has been given to two alternative approaches for industrial classification: a demand based approach and a supply based approach. A demand or market based approach would group establishments (or perhaps some other unit of the firm) into industries on the basis of the demands for their products. A supply or production based approach would group establishments into industries on the basis of their production processes.

[4] See Triplett (1990) for a more detailed discussion of functional aggregation and other aggregation concepts. Rather than focusing on standard human capital variables, Triplett (1990) stresses the importance of looking at what workers do on the job.

[5] Of course, workers also choose whether or not to work and how many hours to work. Standard models of labor supply focusing on these questions are not directly relevant to the present discussion. However, they are important to keep in mind for many purposes to which occupational data are put. For instance, if the supply of workers to a particular occupation is being examined, there may be many people not working, as well as working in other occupations, who are qualified to do that job. Increasing wages or improving other job attributes will draw some of those persons into the market. Most data sets do not provide this information. Longitudinal household data sets could provide some insights of this type.

[6] The literature on equalizing differences has also found compensating wage differentials for locational characteristics such as climate and crime and for elements of non-

wage compensation. However, regional attributes that entail compensating wage differentials are not relevant in classifying occupations. Theoretically, it seems desirable to consider wages and non-wage compensation as dimensions of compensation broadly defined rather than to consider non-wage compensation as an attribute of a job. The distinction appears to have to do with the fact that employers can fairly easily adjust non-wage compensation. Of course, producers can sometimes change jobs' attributes. For example, some jobs requiring heavy lifting or imposing pollution disamenities could be redesigned through use of different equipment. There are some job attributes, though, that could not be changed at any reasonable cost: for example, underground mining jobs or jobs washing windows in high-rise buildings are inherently dangerous.

[7] More technically, for an individual worker, supply-side criteria would dictate grouping available jobs on the basis of his or her preferences. Individuals would be grouped according to similarity of their preferences.

[8] In our sample, individuals' occupations are classified according to the 1980 Census codes. The codes were revised in 1990, but the revisions were fairly minor.

[9] Each housing unit selected to be in the CPS is initially in the sample for 4 consecutive months, then leaves the sample for 8 months, and then re-enters the sample for 4 months before leaving permanently.

[10] Out of our inital sample of 53,136 workers, 101 individuals had an imputed hourly wage that was less than or equal to $1 and 12 individuals had an hourly wage that was greater than or equal to $100. Careful examination makes one doubt the accuracy of these wages. Dropping the outliers raises the proportion of the variance in wages that is explained by the 3-digit occupation codes from .25 to .33, but does not affect our results concerning the amount of the initial information that is preserved after aggregation. Dropping the low wage outliers has almost no effect on the occupation means. Dropping the high wage outliers significantly reduces the means in only a couple of occupations, most notably "dancers" and "news vendors." Like most of the occupations in our sample, these occupations contain only a few observations. As a result, a high wage outlier raises the mean wage. In the occupation, "dancers," the "problem" individual appears to have severly underreported hours worked (perhaps because he only reported hours performing).

[11] "Topcoding" is another problem that needs to be mentioned. To ensure that individuals in the sample cannot be identified, the CPS does not report weekly earnings above some maximum level. In 1989, weekly earnings were topcoded at $1,923. In our data set, 226 individuals were topcoded. Clearly, the imputed hourly wage for an individual with topcoded earnings will be biased downward. However, it is not clear a priori whether or not this imputed wage will be above or below those of other individuals in the same occupaton because individuals with topcoded earnings tend to have an unusually high wage (they also tend to work an unusual number of hours). In our sample, it turns out that omitting individuals with topcoded earnings lowers the average wage in every occupation (although in most cases, not by very much). We have therefore kept topcoded individuals in the sample—omitting topcoded individuals would increase the amount by which we underestimate wages. An alternative approach would be to estimate a wage distribution for each occupation and then use this distribution to impute the wages of topcoded individuals. However, this approach is problematic because the fact that most of the 3-digit occupational codes contain only a few observations means that it is unlikely that we could estimate wage distributions within occupations with much precision.

[12] As an indication of this error, according to the CPS about 30 percent of workers switch occupations each month. This incredibly high number is undoubtedly largely due to interviewers often coding the same job differently in successive months. Of course, it is likely that the cross-sectional error is considerably lower than the error in "gross flows". For example, if someone is correctly coded as a registered nurse in January, incorrectly coded as a physician's assistant in February, and then correctly coded as an R.N. in March, his or her occupation will be incorrectly coded in only 1 month, but in 2 different months the data will indicate incorrectly that he or she switched occupations.

[13] Recall that while there are 503 3-digit occupations, our sample contains no information on 10 of these occupations. They are therefore excluded from the analysis.

[14] Welch and MaClennan explored the effect of allowing rearrangements for aggregates involving a fixed number of clusters. They found that for aggregates involving nine clusters, the proportion of the initial variance preserved rose from 98 percent to 98.3 percent. For aggregates involving two clusters, the proportion of initial variance preserved increased from 52.2 to 67.1 percent.

[15] Welch and MaClennan are correct in pointing out that sparse occupational codes may not contain much information. Still, it may make very good sense to have 15 detailed codes for professors and only 1 or 2 codes for truckdrivers. Professors teaching different subjects have very different specific skills and have obtained very different specific training. Truck drivers are much more homogeneous with respect to their skills and training. Put differently, different truck drivers are likely to be very substitutable with one another in the production process, but physics and fine arts professors are not. We will return to this point below.

[16] Our clusters are in broad accord with those obtained by Welch and MaClennan, suggesting that this type of clustering provides some constancy over time, a desirable feature of any classification system.

[17] Note that if occupation A has a higher average wage than occupation B, then it is very likely to have a higher average log wage than occupation B because the log wage is a monotone transform of the wage. As a result, the difference between the two aggregations lies mainly in the break points between clusters.

[18] The sex and race variables may also capture preference differences or market discrimination.

[19] As before, most of the additional information provided by the occupational codes is preserved upon broad aggregation. Specifically, we can define the residual occupational wage effect as the effect that remains after taking the human capital variables into account. Clustering on the residual wage effects, we find that aggregation to 10 clusters preserves 98 percent of the wage information. As was the case when we clustered on wages and log wages, we find that the residual wage effect is positvely correlated with education: occupational clusters with a higher mean education have a higher residual wage effect. In fact, the relationship is perfect. (Nevertheless, as was true when we clustered on wages and log wages, there is still a great deal of educational variation within each cluster.)

[20] These findings seem somewhat at odds with the "efficiency wage" literature that stresses the importance of industry wage differences. (Of course, the Census occupational categories contain some industry distinctions.) In the future we hope to investigate whether the industry wage effects that other authors have found are simply due to uncontrolled for occupational differences across industries.

[21] A possible data source is provided by Miller, Treiman, Cain, and Roos, 1980. The April 1971 CPS has been coded with third edition DOT codes as well as the 1970 Census occupation codes. Using the April 1971 CPS, Miller, Treiman, Cain, and Roos average the DOT job attribute scores across all individuals in each Census occupation.

[22] Current classification systems make an attempt to distinguish supervisors from other workers. At first glance, this may seem to be a classification based solely on function. However, workers in non-supervisory positions are not interchangeable with supervisors. Workers are promoted to supervisory positions only after they have acquired sufficient experience and demonstrated certain (hard to measure) management skills to justify their being entrusted with the extra responsibility.

[23] Note that it is not clear how we could use the CPS data for an ideal test of Reich's hypothesis. Clearly, symbolic analysis is correlated with education, but the fit is not perfect even within more narrowly defined fields. For example, some computer programmers do very routine production-type tasks, while many are prime examples of what is meant when we think of symbolic analysts. It may be very difficult to distinguish clearly in any system between computer programmers (or other types of workers) who are creating and doing new things and those who are doing very routine functions.

[24] Other sources of the within-occupation variance include error in measuring wages and occupation, use of age as an imperfect proxy for experience, use of wages instead of a more complete measure of compensation, and short-run disequilibrium within labor markets.

[25] Note that education, like the existing occupation codes, provides (imperfect) information about both skill type and skill level. Experience provides (imperfect) information about skill level.

Table 1. Proportion of the variance in wages and log-wages explained by clusters of 3-digit occupations

	Number of clusters	R-squared
Wages	493	0.333
	10	0.326
	2	0.233
Log wages	493	0.406
	10	0.399
	2	0.377

The 46 2-digit Census occupational codes explain 28 percentof the variance and the 14 1-digit Census occupational codes explain 21 percent of the variance in wages.

Table 2. Ten occupational clusters that preserve the most wage and log-wage information

Cluster name	Number of observations	Mean wage	Mean education
Wage information			
Low service and low sales	6,183	5.09	11.75
Low clerical, low technical, and service	6,065	6.43	11.99
Technicians, clerical, and operatives	11,432	8.14	12.50
Transportation, high clerical, machine operators	5,955	9.45	12.53
Precision production, crafts, and high sales	8,482	11.35	13.69
Precision production, foremen, low professional	6,203	13.42	14.18
Managers and administrators	5,643	14.92	14.87
Marketing, financial, and professors	2,413	17.61	15.77
Engineers, lawyers and other professional	521	20.43	16.83
Medical scientists, judges, and pilots	126	26.49	16.44
Log-wage information			
Household workers (childcare and cooks)	197	0.908	11.20
Cashiers, waiters, and other low service workers	6,042	1.56	11.78
Low sales and low service	5,330	1.755	11.86
Low clerical and low technical	5,018	1.923	12.55
Clerical and operatives	9,793	2.07	12.58
High clerical, machine operators, and high sales	6,251	2.21	12.79
Precision production, and low professional	6,417	2.37	14.09
Managers and precision production	7,543	2.51	14.18
Professionals and administrators	3,651	2.61	15.13
High professionals	2,781	2.82	15.94

Table 3. The largest occupations in each wage based cluster

Occupation number	Name	Number of observations	Occupation number	Name	Number of observations
	Low service and low sales			*Low clerical, low technical, and service*	
276	Cashier	1,263	453	Janitors and cleaners	1,066
436	Cook	905	447	Nursing aides, orderlies	749
435	Waiters/waitresses	761	274	Sales workers	746
877	Stock handlers and baggers	479	319	Receptionists	399
479	Farm workers	378	744	Textile sewing operators	367
	Technicians, clerical, and operatives			*Transportation, high clerical, machine operators*	
313	Secretaries	2,028	804	Heavy truckdriver	862
337	Bookkeepers	878	777	Machine opereators, n.e.c.	494
889	General Labor	595	308	Computer Operator	419
785	Assemblies	574	796	Production inspectors	346
389	Admin. support n.e.c.	514	505	Automobile Mechanic	310
	Precision production, crafts and high sales			*Precision production, foremen, low professional*	
243	Sales supervisors	1,253	259	Sales rep: manufacturing	680
156	Elementary teachers	831	633	Supervisors, production	649
567	Carpenters	507	157	Secondary school teachers	624
257	Automotive apprentice	279	23	Accountants	599
783	Welders and cutters	278	575	Electricians	303
	Managers and administrators			*Marketing, financial, and professors*	
19	Managers/admin. n.e.c.	2,809	64	Computer system analysts	272
95	Registered nurse	839	13	Managers and marketing	262
25	Other financial officers	318	7	Financial Manager	222
14	Admin., education fields	302	57	Mechanical engineers	136
5	Public admin. and official	292	56	Industrial engineers	124
	Engineers, lawyers, and other professional			*Medical scientists, judges, and pilots*	
55	Electrical engineers	230	226	Airplane pilots	46
178	Lawyers	221	83	Medical scientists	19
48	Chemical engineers	28	179	Judges	18
69	Physicists and astronomers	19	47	Petroleum engineers	13
66	Actuaries	7	45	Metallurgical engineers	9

Table 4. Log-wage regressions

Explanatory variables	(1)	(2)	(3)
Constant	0.254 (.019)	0.638 (.118)	0.646 (.117)
High school degree	0.180 (.006)	0.092 (.005)	0.082 (.005)
Some college	0.304 (.006)	0.150 (.006)	0.142 (.006)
College degree	0.550 (.008)	0.282 (.008)	0.274 (.007)
Graduate education	0.664 (.008)	0.384 (.009)	0.380 (.009)
Age	0.070 (.001)	0.049 (.001)	0.043 (.008)
Age squared	−0.0007 (.000)	−0.0005 (.000)	−0.0004 (0.000)
Male	0.288 (.004)	0.210 (.005)	0.190 (.005)
White	0.043 (.011)	−0.003 (.009)	−0.0007 (.010)
Black	−0.059 (.013)	−0.051 (.011)	−0.060 (.011)
Union	No	No	0.212 (.005)
Occupational dummies	No	Yes	Yes
Industry dummies	No	No	Yes
R-squared	0.37	0.51	0.54

Standard errors are reported in parentheses.

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Classification Schemes and the Study of Social Mobility: A Detailed Examination of the Blau-Duncan Categories

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Abstract

The Blau-Duncan system of 17 occupational categories has frequently been used as the basis for the study of social mobility patterns in the contemporary United States. In this paper, we examine the validity of these categories by subdividing them in various ways and examining the mobility flows in this more detailed classification. Initial log-linear and cluster analyses using data from the Occupational Changes in a Generation II (OCG-II) survey suggest that the Blau-Duncan scheme hides certain patterns of social structuration, and we form new classification systems on the basis of these results. However, cross-validation analyses using the cumulative General Social Survey data set show that the improvements associated with our schemes do not generalize beyond the OCG-II data. Thus, we recommend continued use of the Blau-Duncan categories, given that they have been employed so often in previous work.

Introduction

The Blau-Duncan system of 17 occupational categories has frequently been used as the basis for the study of social mobility patterns in the contemporary United States. Sometimes mobility tables utilizing all 17 categories—or a substantial portion thereof—have been analyzed (Blau and Duncan 1967; Hout 1988), while at other times aggregations of the original Blau-Duncan groups have been employed (Featherman and Hauser 1978; Hout 1984).

Early users of the Blau-Duncan scheme focussed on the socioeconomic dimension of social mobility, in light of evidence that these categories could be approximately ranked using socioeconomic criteria (Blau and Duncan 1967:Table 2.1; Featherman and Hauser 1978:25–38). However, some overlap among the categories with respect to criteria such as average education and income was noted (Featherman and Hauser 1978:25–26).

In addition, recent work has increasingly stressed the importance of utilizing classification schemes that allow one to study the non-socioeconomic dimensions of social mobility. Most notable in this regard is the research of Erikson, Goldthorpe, and Portacarero. They created a categorization system in the neo-Weberian tradition to "resurrect class structure as the conceptual context of mobility research during the 1970's, in response to a number of perceived theoretical, substantive and methodological weaknesses in the hitherto dominant status attainment paradigm represented by the work of Duncan and his associates" (Marshall 1990:55). It thus seems appropriate to consider in greater detail the adequacy of the Blau-Duncan scheme for the study of social mobility in the United States.

In what follows, we examine the validity of the Blau-Duncan categories by subdividing them in various ways and examining the mobility flows in this more detailed classification. In the past, researchers have often utilized mobility patterns to address the classification problem (for example, Featherman and Hauser 1978:25–38; Goodman 1981; Breiger 1981; Snipp 1985; Levine 1988; 1990). Are the components of the Blau-Duncan categories homogeneous with respect to mobility patterns? If most of the variance in origin to destination transitions is between the Blau-Duncan groups, it might be justifiable to combine them. If not, perhaps the Blau-Duncan system needs to be revised.

The Detailed Classification Scheme

Our desire to create a detailed classification scheme necessitated the use of a data set with a large sample size, so we chose the Occupational Changes in a Generation II (OCG-II) survey as most suitable for our purposes (see Featherman and Hauser 1975). Although these data pertain only to men, no other sample is large enough for an analysis that features a very disaggregated classification system. These data contain extensive information

regarding the jobs of respondents, which we draw on to expand the Blau-Duncan scheme. Specifically, we utilize the 3-digit 1970 Census codes for industry and occupation, as well as information on class of worker, to construct the system of 44 categories displayed in appendix A; the Blau-Duncan categories are also presented in appendix A. To be terminologically precise we refer to these 44 groups as a job (as opposed to occupational) classification scheme, because we are using criteria in addition to occupation to construct the categories. In forming this detailed classification, we were guided both by theoretical perspectives and empirical evidence concerning social barriers and divisions in the United States.

Occupational classification schemes usually seek to group jobs that require similar technical skills or activities, and these technical features tend to be fairly strongly related to the socioeconomic aspects of jobs (Jencks, Perman, and Rainwater 1988:1328). However, there are also many important characteristics of jobs that do not involve socioeconomic criteria. Empirical studies on labor markets suggest that some jobs may be "good" or "bad" depending on the industry or sector (Stolzenberg 1975). Other analyses have pointed to a variety of nonmonetary dimensions along which jobs can be differentiated (Jencks, Perman, and Rainwater 1988:1328). To the extent that occupational classifications do not take these other features of jobs into account, they may fail to capture important barriers to mobility in a social system. Although we cannot consider all possibly relevant aspects of jobs, we do elaborate the Blau-Duncan scheme in ways we feel might reveal additional information concerning the mobility regime.

The two professional categories in the Blau-Duncan scheme were expanded into nine in our classification. We left the self-employed professionals category unchanged, given the relative homogeneity of this category; in the OCG–II data, almost 50 percent of these people are dentists, lawyers, and physicians ("the free professions"). However, we disaggregated the salaried professionals by sector (governmental versus nongovernmental) and area of activity, seeking to differentiate some of its component groups according to market power, formalization of barriers to entry, prospects of career advancement, and other factors affecting job mobility (Sarfatti-Larson 1977; Freidson 1986). We also created two separate semi-professional categories (mainly various types of technicians), which were part of the salaried professionals in the Blau-Duncan scheme. They differ from full professionals in that their training is shorter and their body of knowledge is less specialized. They also enjoy less autonomy from supervision and societal control over their activity (Etzioni 1969; Hall 1975).

The single category of managers in the Blau-Duncan scheme was replaced with four in view of the heterogeneity of this group. Previous research has demonstrated that these are organizationally based occupations—with a major exception in the case of proprietors, which shapes the career paths of managers in a distinct way (Hall 1975). We tried to capture this feature in our classification. Further, there were clear socioeconomic status distinctions among certain occupations in this group, such as the difference between managers of small establishments (such as restaurants) and other managers.

In the Blau-Duncan scheme there were two sales categories: Sales-retail trade and sales-other. Given the expanding body of research on labor market segmentation (Stinchcombe 1979; Tolbert 1983; Boje 1986), we decided to create two additional groups: Sales-manufacturing and sales-wholesale trade.

We divided clerical workers into higher and lower groups based on the complexity of their occupational roles (Blau and Duncan 1967; Baron 1981), and also distinguished them according to sector. This resulted in four categories: High clerical-government; high clerical-nongovernment; low clerical-government; and low clerical-nongovernment. The "high-low" distinction was applied to deal with the diversity of occupations in this category, which includes everything from real estate appraisers to file clerks. According to a substantive complexity score developed by Roos and Treiman (1980:Table F–2) using data from the *Dictionary of Occupational Titles*, the high clerical occupations are more complex on average than the low clerical occupations: the difference is 1.5 points on a 0–10 scale. The division by sector sought to capture the distinctiveness of civil service workers (David and Pollock 1957; Warner et al. 1963).

As far as skilled workers are concerned, a great deal of evidence points to internal differentiation in the craft and foremen categories, both in terms of job experience and life-orientation (for example, Aronowitz 1974). Form (1982), for example, wrote that self-employed craftsworkers differ from other craftsworkers in that they have greater job autonomy, earn higher wages, complete higher levels of general and vocational education, and experience less job mobility. Blue-collar supervisors also occupy an interesting position: they "straddle the barrier between management and labor and maintain a dual loyalty" (Caplow 1964). Their origins among skilled workers leads to a certain amount of sympathy towards the people they supervise, but, at the same time, their ties to management and desires for career mobility put them in a position of marginality and ambivalence (Chinoy 1955; Miller and Form 1964). To capture the differentiation among skilled workers, we expanded this category from three to nine groups by distinguishing craftsworkers not only according to industry, but also according to autonomy; groups for self-employed workers and blue-collar supervisors were created.

Originally, the Blau-Duncan scheme divided operatives and laborers by industry (manufacturing versus other). We decided to further disaggregate these groups accord-

ing to industry by adding two operatives categories (construction and transport) and one group of laborers (construction) to the Blau-Duncan classification. Construction work differs from other manual work in that it is more seasonal, turnover is more extensive, and labor unions are less powerful (Villa 1982; Moore 1982). In addition, Myers (1946) has argued that recruitment into construction positions is somewhat unique in that it depends heavily on personal ties. This is because construction work takes place in relatively small groups.

Service workers comprise perhaps the most heterogeneous group in the Blau-Duncan scheme. This category includes occupations as different as detectives and low-level manual employees. Therefore, we decided to subdivide the category, taking into account the distinctiveness of protective service workers—which form a separate major occupational group in the 1980 Census—and work complexity. Concretely, we created three categories: protective service; other nonmanual service; manual service. The nonmanual and manual service workers differ by about 1.5 points on average according to the substantive complexity score of Roos and Treiman (1980:Table F–2).

Methodology

Our analyses are based on a mobility table which cross-classifies father's (or other family head's) job by son's current job for respondents aged 20–64. For reasons detailed in Featherman and Hauser (1978:appendix B) we use weighted cell counts, and the resulting mobility matrix is presented in table A1. Following Hout (1989:48–50), we begin by comparing the likelihood ratio chi-square (L^2) for the model of statistical independence applied to the 44 by 44 table (6846 with 1849 df) to that for the 17 by 17 table formed using the Blau-Duncan categories (4913 with 256 df). The difference of almost 2,000 between these two values shows that considerable information is lost when the categories in the larger table are combined to form the smaller table, so it is worthwhile to examine the 44 by 44 table more closely. In addition, this quantity can be used to statistically test whether the model of perfect mobility fits the subtable formed by the rows and columns in the 44 by 44 table that would need to be combined to form the 17 by 17 table (Goodman 1981:644); if it fails to fit, we are not justified in collapsing the 44 categories to the Blau-Duncan 17. The difference (1933 with 1849–256=1593 df) is indeed statistically significant, which means that the model of perfect mobility does not fit the data in the subtable and the categories in question should not be combined.[1]

We analyze this matrix utilizing a log-linear model. Among the many models available, we chose the generalized distance model developed by Levine (1967; 1972; 1990; 1993), which is displayed in Equation 1. This model says that the expected frequency of mobility between two categories, net of row (R_i) and column (C_j) effects, is inversely proportional to the "social distance" between them, with distances (or interaction effects) estimated from the data.

$$\hat{F}_{ij} = \frac{R_i C_j}{e_{ij}^{d} + pd_{ij}^{2}}$$

(1) The distances from this model are true metric distances in the mathematical sense. Thus, the model is symmetric, a feature which Hauser (1987:807) has deemed "parsimonious and substantively important" for mobility models. The distances are measured using the city-block metric:[2]

$$d_{ij} = \sum_{K=1} \left| X_{ik} - X_{jk} \right|$$

(2) Goodness of fit is assessed using Pearson's chi-square, and models with differing numbers of degrees of freedom are compared using BIC, the percentage of association explained, and the following statistic:

$$X_Z = \frac{\left(X^2 - df\right)}{\sqrt{2df^3}}$$

The choice of a quadratic function of distance in (1) is closely related to the underlying nature of mobility processes. The first term, which is comparable to the interaction parameter used in crossings models (Goodman 1972), says that mobility declines in direct proportion to distance. By contrast, the second term, which is comparable to the interaction parameter used in row and column effects models (Goodman 1979) says that mobility declines more sharply at greater distances. Thus, the first-power term captures the strong diagonal/off-diagonal effects found in mobility tables, whereas the distance-squared term models the very small frequencies typical of the upper-right and lower-left corners of a mobility table. For further detail on these two terms, see Levine (1993:Chapter 5).

The generalized model applies, at once, to all cells of the table, using one equation for both on-diagonal and off-diagonal cells. Many commonly-used models for mobility tables restrict their domain to non-diagonal cells, a practice that Duncan (1979:801) has criticized as ad hoc. But generalized distance models are intrinsically parsimonious, because the point of zero distance (the diagonal) naturally generates special predictions. Under the generalized distance model, the uniqueness, if any, of the diagonal cells requires no special-purpose theoretical assumption.

This model is also well suited to our particular purposes, because it provides easily interpretable results for

very large tables. The coordinates which generate the distances can be plotted and the position of categories in the "social space" can be examined. It is then possible to ascertain whether the components of the Blau-Duncan categories are heterogeneous with respect to mobility, since the locations in social space are estimated directly from the data.[4]

Other types of log-linear models, such as topological models (Hout 1983:Chapter 4), do not allow such distance interpretations. In addition, Levine's model is more general than other "social distance" models, such as Goodman's RC-II model and its multidimensional extensions (Goodman 1979; 1985; Smith and Garnier 1987): Levine's model allows for any polynomial function of distance (the functional form is implicit in Goodman's models), it is multidimensional, and the dimensions in the model are not constrained to be orthogonal to each other—the correlation between any two dimensions is what it is in the data. In the context of social mobility analysis, Hout (1984:1384) has convincingly argued that such orthogonality constraints do not make sense and are unlikely to lead to meaningful depictions of social space.

We utilize the results from the log-linear analyses to form a new 17-category classification scheme. Taking as input the distances generated by Levine's model, we apply cluster analysis to the 44 categories using Johnson's (1967) maximum distance method; this method has been popular in previous research (Vanneman 1977; Haller, Kurz, and Koenig 1985). For comparative purposes, we also use a clustering technique that combines those two categories which, when joined, least reduce the total amount of information (L^2 under statistical independence) in the data (see Goodman 1981; Hout 1979:48–50).[5]

Findings

The distance model. Table 1 presents goodness-of-fit statistics for various distance models applied to the OCG-II intergenerational mobility data. As can be seen from the table, there is a rapidly diminishing return in terms of goodness-of-fit when the increased number of parameters necessary for higher-dimensional solutions is considered. In particular, model performance does not improve much once a three-dimensional solution is obtained: BIC, the percent of association explained, and X_z change minimally when the fourth and fifth dimensions are added. Thus, we chose to concentrate on the three-dimensional model. This model fits the data fairly well, with a X^2 of 1777.97 and a X_z of 1.006.

The three-dimensional solution is pictured in Figure 1.[6] Appendix A lists the Blau-Duncan groups to which the 44 categories belong. In general, our hypotheses concerning the heterogeneity of the Blau-Duncan categories are confirmed. Consider the salaried professionals. The components of this category occupy a sizable portion of the space, and it seems particularly inappropriate to include government professionals and health semi-professionals with the other groups in this category.

The managerial group does not appear to be as heterogeneous as the salaried professionals, although financial managers and managers of small establishments exhibit mobility patterns that are somewhat distinct from the other components of this Blau-Duncan category. Sales workers seem to be fairly homogeneous as regards mobility experiences, but clerical workers display quite diverse mobility patterns, with higher status clerical employees in the government sector being separated by a considerable distance from the other clerical workers.

With respect to manual occupations, the industrial distinction between construction workers and those in other industries stands out on the map. This is consistent with our earlier discussion of the ways in which construction work differs from work in other industries. In addition, construction foremen seem to be more similar to construction operatives than to either construction craftsmen or those who are self-employed. This is also undoubtedly due to the nature of construction work, in which foremen tend to supervise large, semi-skilled crews, while craftsmen are most likely engaged in more highly-skilled, autonomous, and creative work.

The self-employed distinction also seems to be of some importance among skilled manual workers. Self-employed manufacturing workers, for instance, are separated by a considerable distance from other skilled workers in manufacturing, and, when compared to their skilled counterparts, self-employed construction workers display somewhat unique mobility experiences as well. Finally, as anticipated, the components of the Blau-Duncan service category exhibit quite diverse mobility experiences. Men in nonmanual service work appear to have mobility patterns that are different from those in other types of service occupations.

The cluster analysis. Table 2 presents the systems of 17 categories generated by the two methods of cluster analysis described earlier.[7] The methods yield somewhat different results, but in neither case does the cluster analysis result in a scheme that is close to the Blau-Duncan set of categories. Utilizing Johnson's maximum distance method, no Blau-Duncan groups result. According to the percent of association method, only the self-employed professional, sales (retail trade), proprietor, farmer, and farm worker groups have equivalents in the Blau-Duncan scheme.

Although the imposition of seventeen categories—an arbitrary number—yields some groups which are not easily labeled, there are clearly aspects of social structuration in the OCG-II data that the Blau-Duncan classification masks. As a result, certain types of mobility flows cannot be discussed under the rubric of the Blau-Duncan cat-

egories. For example, both clustering methods point to the diversity of salaried professionals, with the components of this group being spread across five categories in the first clustering method and three in the second. In addition, construction work seems to be structured differently than Blau and Duncan thought, with Johnson's method placing construction work in three clusters (skilled construction, semi-skilled construction, semi-skilled/unskilled in nonmanufacturing industries), and Goodman's method producing two construction categories (skilled/semi-skilled construction and unskilled construction). Further, none of the components of the Blau-Duncan service group end up in the same cluster.

Evaluating alternative classification schemes. Before taking the results from the cluster analyses too seriously, we must compare the various classification schemes using some quantitative criterion. Let us assess how much information each of the category systems yields. Recall that L^2 under statistical independence for the Blau-Duncan table was 4913. For the table formed using the maximum distance clustering solution, L^2 was 4642, while it was 5137 using the percent of association clusters. This means that the maximum distance clusters hide information when compared to the Blau-Duncan groups, but the classification created by the other clustering method seems to reveal some additional information.

To ascertain whether the scheme formed by the percent of association clustering method generally reveals additional information, however, it is important that we not limit our analyses to the OCG-II data set. This is because our analysis is designed to maximize the explanation of mobility patterns in these particular data, so on this basis alone we would expect differences between our scheme and the Blau-Duncan system; the latter was devised independently of any particular set of mobility data (see also Hauser and Logan 1992). To compare the classifications we carry out a cross-validation analysis by fitting the model of statistical independence to three tables generated using the cumulative General Social Survey data (1972–1991) for men aged 20–64.[9] The first table featured the Blau-Duncan categories, the second the maximum distance clusters, and the third table utilized the groups created by the percent of association clustering. For the Blau-Duncan table L^2 was 2167, while it was 2208 for the maximum distance table and 2180 for the percent of association table. This means that there is little difference among these classification schemes in terms of the amount of information revealed.

Discussion and Conclusion

Where do these results leave the student of social mobility? Is it valid to continue to use the Blau-Duncan scheme? If not, is there another, more preferable categorization system, or should such classification schemes be abandoned altogether?

In one sense, the classification scheme employed does not seem to be of great consequence. An important empirical result for intergenerational mobility tables does not seem to depend much on the type of classification scheme employed: the value of the first canonical correlation between father's job and son's current job drops by only about 11 percent (from .386 to .348) when one aggregates our 44 categories to form a three-group system (nonmanual/manual/farm).

However, researchers often want to move beyond such basic measures of the association between social origins and destinations to an exploration of precisely where in the social structure differences in mobility chances occur. A satisfactory approach to this problem, especially if the research is to have any value for social policy purposes, demands a categorization scheme with more than three categories. At the same time, though, given the various problems involved with a very large number of categories (such as sparse tables), some type of aggregation seems necessary.

Given that the category systems proposed here did not outperform the Blau-Duncan classification in a cross-validation analysis, we see no compelling reason to begin utilizing a different set of categories. Most importantly, over-time comparability favors continued use of the Blau-Duncan groups, given that so many previous analyses have employed them.

In addition, results from the approach utilized in this paper reveal several limitations of techniques that seek to form categories based on observed mobility patterns. First, the cross-validation procedure suggests that such techniques may be quite sensitive to the peculiarities of the sample used for analysis. Otherwise, the revised categories would perform better than the original ones in more than one sample. Second, the two clustering techniques lead to distinct category systems. In part this is due to differences in how the clusters were formed: the maximum distance method utilized interactions from a log-linear model, while the other method operated on the entire mobility table. However, if the data strongly suggested a particular set of categories, we would expect the two methods to have lead to more similar results. Third, some of the categories in table 2 are very difficult to label, again suggesting that idiosyncratic mobility patterns are being captured.

These limitations could be used to argue in favor of a priori construction of category schemes. After all, it is undesirable to create a different set of categories each time a new data set is analyzed, given that fruitful comparative inquiry requires a standard classification system. Erikson and Goldthorpe (1992:Chapter 2) favor an a priori approach, based on their strong theoretical motivation for examining the mobility patterns of certain groups. However, our analyses do call attention to some aspects

of social structuration hidden by the Blau-Duncan system, for example, the distinctiveness of semi-professionals and construction workers, and researchers might want to employ such categories in future analyses. In this connection, the techniques utilized in this paper may have some value as exploratory methods for assessing the validity of categorization schemes. Moreover, the methods employed here might assist researchers in deciding which categories in a cross-classification table can be combined, when it is deemed necessary to reduce the level of detail in a table (cf. Hout 1992:42–7).

One conclusion that can definitely be reached on the basis of this analysis is that scholars need to keep in mind that job categorization schemes have a certain degree of arbitrariness connected with them: it is difficult for data to yield a definitive categorization scheme, because boundary lines are drawn in a mobility space that is essentially continuous (recall figure 1). Therefore, in the absence of other evidence, it is hazardous to view even fairly detailed job categories as actual social groups, when in fact they simply refer to approximate locations in social structure.

Finally, much research remains to be done on the categorization issue. Among other things, it should be kept in mind that our results are based on analyses of men's intergenerational mobility patterns. An analysis of the mobility patterns of other social groups or of other types of mobility may not produce similar results.[9] Also, if suitable data can be found, classifications with more than 44 categories should be examined. Ideally one would analyze true "atoms," such as a very detailed list of jobs.

Notes

[1] The difference between the L^2s when the model of quasi-perfect mobility is applied to each of the tables is also about 2000.

[2] Levine has found that his model best fits mobility data when the city-block metric is employed (as opposed to, e.g., the Euclidean metric).

[3] Strictly speaking, it is inappropriate to use BIC and percent of association explained in connection with Pearson's chi-square, because both of these measures were developed utilizing the properties of the likelihood ratio chi-square statistic. We use them as rough guides and note that all three of our indices of model performance lead to the same conclusion regarding model selection.

[4] We estimate the parameters of this rather complex model using a computer program developed by Joel Levine. The program uses steepest descent techniques to compute estimates that minimize Pearson's chi-square, and it is available from the authors for either an IBM or a Macintosh personal computer. To identify the parameters, Levine constrains the coordinates to sum to zero and the coefficient of the first-power distance term to equal 1. Absolute (as opposed to a local) minima are found by running the program many times with different, randomly chosen starting values.

[5] This technique simultaneously collapses rows and columns, including the diagonal entries. As stated earlier in the paper, excluding the diagonal is an atheoretical, ad hoc procedure.

[6] The coordinates used to generate this plot are available from the authors upon request.

[7] Details concerning the cluster analyses—including dendograms—are available from the authors upon request.

[8] The cumulative data set is used in order to maximize the number of cases available for analysis. There is little over-time heterogeneity in mobility patterns in these data (see Krymkowski and Krauze 1992:153).

[9] Levine (1990), for example, found industrial distinctions to be very important in his analysis of short-term career mobility.

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Appendix A.

The Blau-Duncan scheme

(1) Self-Employed Professionals
(2) Salaried Professionals
(3) Managers
(4) Salesmen, Other
(5) Proprietors
(6) Clerks
(7) Salesmen, Retail
(8) Craftsmen, Manufacturing
(9) Craftsmen, Other
(10) Craftsmen, Construction
(11) Service
(12) Operatives, Other
(13) Operatives, Manufacturing
(14) Laborers, Manufacturing
(15) Laborers, Other
(16) Farmers
(17) Farm Laborers

The 44 categories

We used 3-digit Occupation and Industry codes as well as information on Class of Worker to create our scheme of 44 categories. In the OCG–II data, this information is coded using 1970 Census classifications. We describe below our 44 categories in terms of their Census classification components. The letters in brackets after the names of the categories refer to the symbols used in figure 1, while the numbers indicate to which Blau-Duncan groups the categories belong.

Self-Employed Professionals [A, 1]
Occupations 1–73, 86–145, 163, 164, 174–195 with Class of Worker code 3.

Government Professionals [B, 2]
Professionals not classifiable in [A]–[F] but with Class of Worker 2.

College Teachers [C, 2]
Occupations 102–140 with Class of Worker other than 3.

Other Teachers [D, 2]
Occupations 141–145 with Class of Worker other than 3.

Engineering Type Occupations [E, 2]
Occupations 2 and 6–23 with Class of Worker other than 3.

Artists [F, 2]
Occupations 175–194 with Class of Worker other than 3.

Other Professionals [G, 2]
Professionals not classifiable in [A]–[F].

Health Semi-Professionals [H, 2]
Occupations 74–85.

Other Semi-Professionals [I, 2]
Occupations 150–162 and 165–173.

Proprietors [J, 5]
Occupations 201–245 with Class of Worker 3.

Public Administration Managers [K, 3]
Occupations 201, 212, 213, 215, 222, 224, 235, 240, 223, and all managers with Industry codes 828–937.

Managers of Small Establishments (e.g., Restaurants) [L, 3]
Occupations 211, 216, 221, 226, 230, and all managers with Industry codes 607–698 and 769–809.

Sales Managers [M, 3]
Occupations 203, 205, 225, 231, and 233.

Financial Managers [N, 3]
Occupations 202, 210, and all managers with Industry codes 707–718.

Other Managers [O, 3]
All managers not classifiable in [J]–[N].

Sales, Manufacturing [P, 4]
Occupation 280 in Industries 107–399.

Sales, Wholesale Trade [Q, 4]
Occupation 280 in Industries 17–58 and 507–599.

Sales, Retail Trade [R, 7]
Occupation 280 in Industries 607–699, and Occupations 262, 264, and 266.

Sales, Other [S, 4]
All Sales not classifiable in [P]–[R].

High Clerical, Government [T, 6]
Occupations 305, 312, 315–323, 326, 360, 362, 363, 370, 371, 375, 376 with Class of Worker 2.

High Clerical, Non-Government [U, 6]
Occupations 305, 312, 315–323, 326, 360, 362, 363, 370, 371, 375, 376 with Class of Worker other than 2.

Low Clerical, Government [V, 6]
Other Clerical occupations with Class of Worker 2.

Low Clerical, Non-Government [W, 6]
Other Clerical occupations with Class of Worker other than 2.

Self-Employed Crafts, Manufacturing [X, 8]
Occupations 401–580 in Industries 47–57 and 107–398 with Class of Worker 3.

Self-Employed Crafts, Construction [Y, 10]
Occupations 401–580 in Industries 67–77 with Class of Worker 3.

Self-Employed Crafts, Other [Z, 9]
Occupations 401–580 in other Industries with Class of Worker 3.

Foremen, Manufacturing [AA, 8]
Occupation 441 in Industries 47–57 and 107–398.

Foremen, Construction [AB, 10]
Occupation 441 in Industries 67–77.

Foremen, Other [AC, 9]
Occupation 441 in other Industries.

Crafts, Manufacturing [AD, 8]
Occupations 401–580 (except 441) in Industries 47–57 and 107–398.

Crafts, Construction [AE, 10]
Occupations 401–580 (except 441) in Industries 67–77.

Crafts, Other [AF, 9]
Occupations 401–580 (except 441) in other Industries.

Operatives, Manufacturing [AG, 13]
Occupations 601–695 in Industries 47–57 and 107–398.

Operatives, Construction [AH, 12]
Occupations 601–695 in Industries 67–77.

Operatives, Other [AI, 12]
Occupations 601–695 in other Industries.

Operatives, Transport [AJ, 12]
Occupations 701–715.

Laborers, Manufacturing [AK, 14]
Occupations 740–785 in Industries 47–57 and 107–398.

Laborers, Construction [AL, 15]
Occupations 740–785 in Industries 67–77.

Laborers, Other [AM, 15]
Occupations 740–785 in other Industries.

Farmers [AN, 16]
Occupations 801 and 802.

Farm Workers [AO, 17]
Occupations 821–824.

Protective Service Workers [AP, 11]
Occupations 961, 963, 964, and 965.

Other Nonmanual Service Workers [AQ, 11]
Occupations 923, 924, 926, 935, 940, 942, and 944.

Manual Service Workers [AR, 11]
Other Service occupations.

Figure 1. Plot of three-dimensional solution to generalized distance model: Male intergenerational mobility in 1973. (See Appendix A for definition of symbols.)

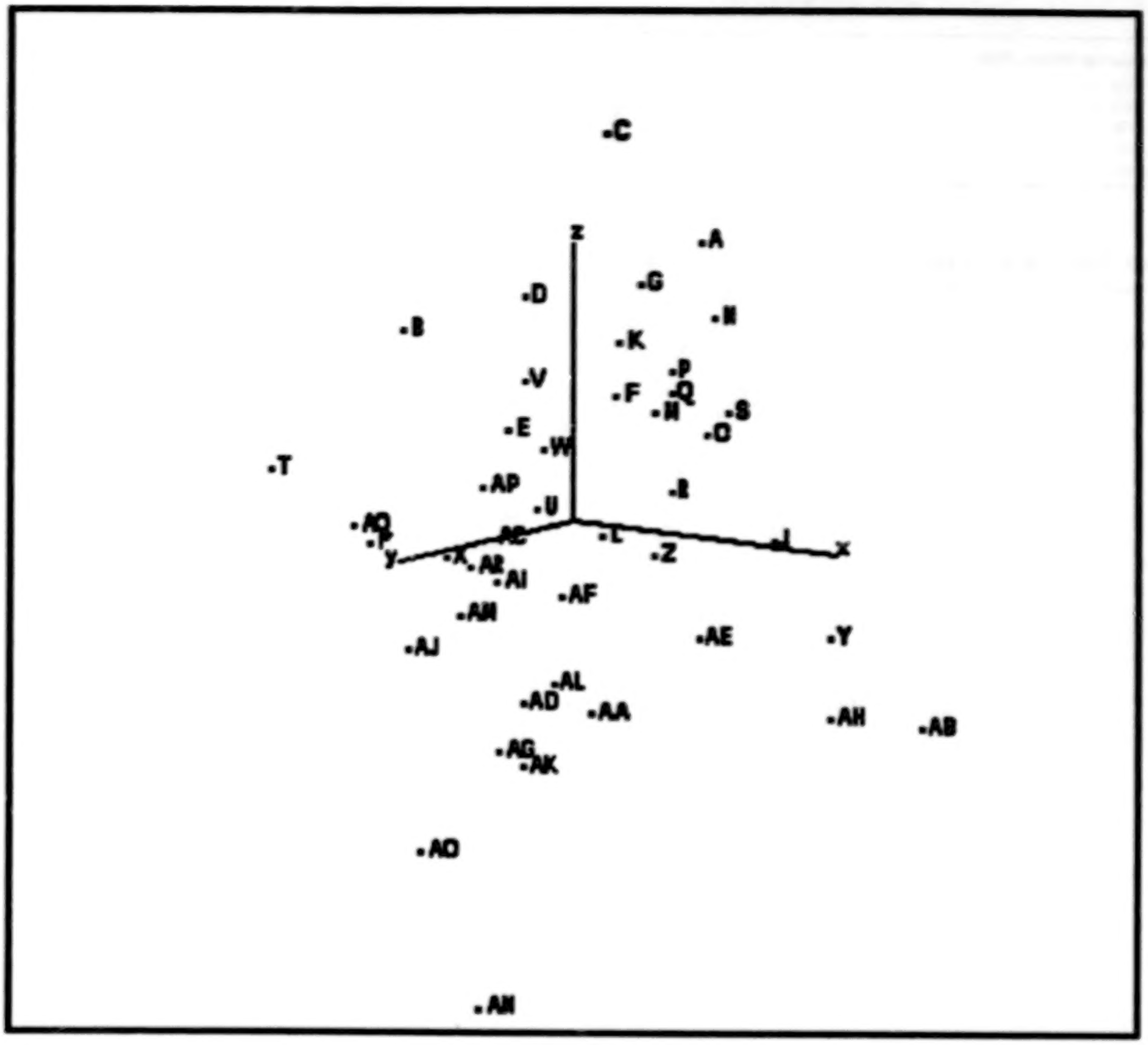

Table 1. Fit statistics from various generalized distance models applied to the 44 by 44 table

Number of dimensions (df)	Pearson's Chi-Square	BIC	Percent of association explained	Chi-Z
Independence model (1849)	8229.17	−10245.11	0	104.92
1 (1805)	3063.39	−14971.26	62.77	20.94
2 (1762)	2336.04	−15268.98	71.61	9.67
3 (1719)	1777.97	−15397.42	78.39	1.01
4 (1676)	1621.72	−15124.03	80.29	−.94
5 (1633)	1482.95	−14833.17	81.98	−2.63

Table 2. Cluster analysis aggregations of the 44 categories

	Maximum distance clustering	Percent of association clustering
1	A, G, N	A
2	B	B, C, E, F, G, N
3	C	D, K
4	D, K	H, I, T, U, V, W, X, AP
5	E, F	J
6	H, X, AQ	L
7	I, U, Z, AF	M, O, P, Q, S
8	J, L, R	R
9	M, O, P, Q, S	Y, AB, AE, AH
10	T	Z, AF, AI, AQ
11	V, W, AC, AP	AA, AC, AD
12	Y, AE	AG, AK
13	AA, AD	AJ
14	AB, AH	AL
15	AG, AK	AM, AR
16	AI, AJ, AL, AM, AR	AN
17	AN, AO	AO

Intuitive Classification of Occupation [1]

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Introduction

Classification is a fundamental human activity. People make sense of their environments by assigning incoming perceptions to mental categories. Natural scientists bring coherence to the biological world by classifying organisms according to formal taxonomies. Statisticians, social scientists, and policy analysts interpret the social world in terms of categories like ethnicity, gender, class, and occupation. Whether formal or intuitive, good classification systems highlight the commonalities within groups of objects and the differences between groups of objects by attaching labels to groups in ways that are meaningful to the users of such systems. When users of a formal system have also developed an intuitive taxonomy for the same domain, the discrepancies between the two systems are likely to affect the usability of the formal system. This paper takes a first look at what mental taxonomies of occupations might be like.

As behavioral scientists working on survey methodology, the authors' mission is to reduce measurement error in the survey process, particularly when that error is cognitive in origin (Biemer, Groves, Lyberg, Mathiowetz, & Sudman, 1991; Tanur, 1992). One potential source of measurement error arises when a classification system is not consistent with its users' intuitions. We are concerned with the usability of an occupational classification system by at least two groups of users: people who produce survey data about occupation (interviewers, occupational coders, questionnaire designers, and technologists) and substantive users of those data (human resource development specialists, social scientists, policy analysts, and others).

This paper reports the results of a pilot study that explores the way jobs are represented and organized mentally for three groups of people. The three groups represent potential users of an ideal occupational classification system, though all differ in their professional knowledge of occupations. The study uses multidimensional scaling (MDS) to make explicit the structure of people's job concepts so that such a structure might help shape a formal classification system. MDS is one of several techniques available to psychologists for extracting people's knowledge, and is presented here as an example of how behavioral science can help engineer usable classification systems. After the study is discussed, several implications for the design of a classification system are considered.

We do not intend to propose an ideal system in the current paper. Instead, our goal is to provoke discussion and to illustrate what might be accomplished in a long-term research project using similar tools. We take literally the charge of investigating underlying principles of an ideal classification system, and so our discussion does not address technical implementation issues.

Concepts of Occupation

One criterion for an ideal occupational classification system is that it be compatible with how users think about occupations. This is valuable from a data production standpoint because the more usable a system, the lower the likelihood of classification errors, and the more accurate the data produced with the system are likely to be. From a data-use perspective, a classification system that resembles users' understanding of occupation may expose pertinent information that is obscured in current reporting aggregations. For example, if users do not have a concept which corresponds to "professional jobs" then statistics about such a category may conceal the information they seek.

We conducted a study to explore how concepts of occupation are affected by (1) proficiency with a formal classification system used to classify survey responses about occupation, and (2) professional and academic knowledge of human resource development. The first of these concerns coding and the production of data. The second concerns use of the data by one type of user. One reason it is important to consider the latter set of issues is because one would probably not want to design a classification system based on constructs that are counterintuitive to data users.

There was a methodological goal to the study as well: to evaluate MDS as a technique for mapping out the mental relations among occupations. MDS has been used widely in psychology to investigate the relations between concepts (for example, Rips, Shoben, and Smith, 1973),

but to the best of our knowledge it has not been applied to occupations.[2] MDS is a multivariate, statistical technique that graphically depicts similarity among objects as proximity along some number of dimensions (see, for example, Young and Hamer, 1987). The closer two concepts are along a dimension in an MDS plot, the more similar they are presumed to be on that dimension in the minds of the subjects who provided the data. It is up to the researcher to interpret the dimensions, so MDS is, in some ways, more of an art than a science. Because its interpretation is largely subjective, MDS is often used to help generate hypotheses that are then tested explicitly with other methods.

MDS fits well with certain psychological theories of concepts (for example, Smith and Medin, 1981), which presumably apply to concepts of occupation. In particular, such theories assume that concepts are defined as a set of attributes that are positions or values on a set of dimensions. These dimensions define all of the concepts within a particular domain and it is the values on the dimensions, that is, the attributes of the concepts, that distinguish one concept from another. As an example, consider *salary* as a dimension that may help define everyday, occupational concepts. Some jobs are distinguished from other jobs by their position on the salary dimension, that is, the amount of salary. Of course other dimensions are needed to define the full universe of jobs which leads to a multidimensional view of job concepts. MDS can help identify the underlying dimensions and locate individual jobs along those dimensions.

We tested multidimensional scaling on a small set of occupations for three groups of subjects. The dimensions we observed presumably play a role in the mental organization of occupations, even if subjects are not aware of using these dimensions. One might simply ask people to list the features that comprise their concepts of particular jobs. But people are not always able to provide that information. One advantage of MDS is that it allows the researcher to infer mental structures without requiring the subjects to directly report those structures.

An example of MDS

Before turning to the central study, consider the following example of how MDS can make explicit the structure of concepts. We asked eight field economists (interviewers) from the Occupational Compensation Survey program at the Bureau of Labor Statistics to judge the similarity of a set of job titles in the classification system developed by that program. This classification system distinguishes between general occupations and up to eight levels within each general occupation, for example accountant level II or engineer level IV. The field economists elicit open-ended responses and then classify those responses in terms of this taxonomy. We presented them with all pairs of accountants levels I–VI and engineers levels I–VI, for example, "engineer II—accountant V," and asked them to rate the similarity of each pair.

A two-dimensional MDS solution is presented in chart 1. It shows a clear distinction between occupations (accountants are in the upper quadrants, engineers are in the lower quadrants) and an ordering based on levels (the levels increase from right to left, with a slight reversal for engineers V and VI). One thing to note is that the occupations at levels IV–VI are closer to each other (for a given occupation) than are those at Levels I–III. This presumably reflects the increasingly managerial nature and less precisely defined characteristics of the higher level jobs. This is a straightforward example because the principle dimensions of the classification system (occupational category and level) have apparently been internalized by the interviewers and MDS recovers this. In contrast, the study carried out for this conference explored the underlying dimensions of the census classification system. Because of the breadth of this system, it was hard to anticipate the results of the MDS analysis. We turn to that study now.

Pilot study

Subjects. We recruited three groups of subjects: 38 Bureau of the Census coders, who use the Census Industry and Occupational Classification[3] system to code open ended industry and occupation responses to questions on the Current Population Survey (CPS); 51 CPS interviewers who collect—but do not code—the industry and occupation responses; 18 graduate students in human resource development (HRD) and adult education, most of whom also work in those fields.

The coders were chosen because it seemed likely that using the census system would influence their understanding of occupations. This group consisted of 31 "production coders" who classify routine responses and 7 "problem referral coders" who classify those responses that are beyond the ability of the production coders. Problem referral coders are promoted to that position for their superior knowledge of the classification system. For these problem referral coders, the average amount of experience using the system was 10.6 years; the production coders averaged 3.2 years. If using a formal classification system affects the users' concepts of occupation, this influence should be most prominent for the problem referral coders.

The interviewers were included because while they do not use the census system, they are potential users of a future system. Such a system would have to be sufficiently usable and appropriately automated so that it might be used during the interviews themselves.[4] While interviewers do not code the responses, they do probe respondents when they believe the response will not be codable, so they may have some knowledge of the problems of coding. However, many of the interviewers in our sample were new to CPS data collection. On average, the interviewers had collected CPS data for 1.9 years.

To the best of our knowledge, they had no familiarity with the actual census codes or the theoretical basis of HRD.

The HRD group was included because as professionals in that field and as students of its academic counterpart they are potential users of data collected with classification systems such as the census system, the *Dictionary of Occupational Titles*, or the Standard Occupational Classification system. A system designed around their understanding of occupational composition ought to facilitate its use by members of their community. In addition, if the theories developed by their colleagues accurately characterize the workforce, the knowledge of the HRD subjects might lead to a system that more closely mirrors notions of occupation based on everyday experience. That should promote usability by people such as interviewers who must rely primarily on such experience. Thirteen out of 18 HRD subjects were currently working in the HRD and adult education fields. These subjects had held their current job for an average of 6.5 years. This probably underestimates their average time in the field because it does not consider prior jobs in the same area.

Procedure. Fourteen jobs at the 3-digit level were arbitrarily chosen from four of the seven top level categories within the census system (Bureau of the Census, 1992). These are presented in table 1. It would have been preferable to select jobs from all of the major categories—our most notable omission being an instance of operators, fabricators, and laborers—but practical constraints lead us to select this particular set of jobs. All possible pairs of the 14 jobs (91 pairs) were formed and the pairs were randomly permuted for each subject (see table 2). In fact, for administrative and organizational reasons beyond our control, the CPS interviewers were presented the pairs made from only 12 jobs (66 pairs). In general, we used a small number of jobs to keep the demand on our subjects low, and their concentration high. As the number of jobs goes up, the number of pairs increases rapidly. Since the subjects' task is performed on every pair, more jobs means many more pairs and a much more demanding task.

The subjects were asked to rate the similarity of each pair on a scale from 0 to 9 where 0 indicates maximum dissimilarity and 9 indicates maximum similarity. The subjects were instructed to define the term "similar" as they deemed appropriate. In principle, the similarity judgment should require some mental comparison of job attributes, even if subjects cannot articulate those attributes. These ratings were collected into a similarity matrix for each subject in which each cell represents a pair of jobs. A matrix was then constructed of average similarity scores across each group of subjects and these matrices were submitted to an MDS program.[5] It is also possible to perform the analysis on individual subject matrices, particularly when one is interested in individual differences (see, for example, Takane and Young, 1977). The particular MDS implementation we used, ALSCAL, uses an alternating least squares algorithm to array the stimuli, in our case occupations, along n dimensions. The next, and most subjective, step is to interpret the dimensions that are produced.

The principal output from the multidimensional scaling program is a set of plots of the job titles along these dimensions. In principle, MDS can generate plots in any number of dimensions, but in practice it is rare to interpret more than three. There are statistical guidelines for determining the maximum number of dimensions, though there is no value in deriving more than are interpretable. The dimensions are, by definition, orthogonal, so the location of a job on one dimension is not affected by its location on the others. We return to this when considering how the method might be applied to developing a classification system.

Results and discussion. The plots for the three groups are quite similar: three interpretable dimensions emerged for each group and we interpreted them the same way in all three cases. To confirm our impression that the three groups rely on the same dimensions in making these judgments, we computed correlations between groups for the locations of the jobs in the plots. Because the interviewers did not receive the full set of 14 jobs we cannot compute correlations between this group and the other groups. However the coordinates on the three dimensions are correlated for the HRD and coder groups. The correlations are .91, $p<.01$; .57, $p<.05$, and .46, $p<.10$ for dimensions one through three respectively, and if we look at the eight coders who are most experienced with the census system, the problem referral coders, the correlations are higher: .91, $p<.01$; .71, $p<.01$, and .73, $p<.01$.

The fact that the plots were so similar across groups of people with different types of occupational knowledge runs counter to what we expected. We expected the coders to reproduce some of the relations in the census system in their scaling solutions, perhaps arraying the occupations as they are numerically coded, while there was no reason *a priori* for the interviewers and HRD subjects, who would not necessarily know these relations, to have shown this pattern. The HRD subjects might have arrayed the jobs along dimensions such as "job satisfaction," while we did not expect the census coders to consider such attributes. Interviewers might have considered the difficulty of eliciting codable responses for the jobs while this should not have been a factor for HRD subjects. The commonality across the groups suggests that intuitive notions of occupation, as they appear in our data, are not perturbed by exposure to professional and academic material about occupation nor by familiarity with a formal classification system. Apparently, the ev-

eryday notions of occupation held by our three distinct groups are relatively universal and quite stable.

If this is true in general, then there should be a single set of principles that characterize most people's understanding of jobs, and those principles could be made explicit and taken into account in developing an ideal classification system. This is encouraging because it could mean that no one group's knowledge must be considered at the exclusion of others' in designing a classification system. We turn now to our interpretations of three dimensions which we believe are plausible, organizing principles for a classification system.

Charts 2 a-b present the MDS solutions in three dimensions for the HRD group as an example of all three groups. Any interpretations of the dimensions are suggestive; none perfectly characterizes the plots. Readers may explain the order and position of jobs differently than the authors do, though it is important to recognize that the subjects may have certain beliefs about the jobs which are evident in the plots but which readers believe to be inaccurate. MDS tells us about what is in the subjects' heads, not what is objectively true.

Dimension 1 is the horizontal dimension in chart 2a. We have labeled it *abstractness*. If the work in a particular job is carried out by manipulating physical objects, like driving nails, such jobs appear on the left end of the dimension[6] (carpenter, household cleaner, etc.); if the work involves manipulating symbols, like preparing documents on a computer, those jobs appear on the opposite end (word processor, underwriter, teacher, etc.); a job which involves a mixture of physical and conceptual work appears in the middle (registered nurse).

Dimension 2 is the vertical dimension in chart 2a. We have interpreted this as a *formal training* dimension. If explicit instruction and study are required to perform a job, it appears on the top end of the dimension (registered nurse, teacher, electrician, underwriter, etc.); if the duties of a job can be learned with relatively little formal training, the job is found at the opposite end (cashier, stock and inventory clerk, household cleaner); intermediate degrees of training locate a job in the middle of the dimension (secretary, maintenance mechanic, etc.). Other possible labels include job satisfaction, prestige, and salary.

Dimension 3 is the vertical dimension in chart 2b. The interpretation we have settled on is a *human services* dimension. The four jobs in the lower quadrants all exist to meet basic human needs: Education, health care, hygiene, and nutrition. The jobs in the upper quadrants are not essential for physical and intellectual well being. Instead they are primarily construction and business related jobs. The stability of this dimension over the three groups suggests that it is meaningful to subjects even though it was not mentioned in these terms by any subjects in a follow-up questionnaire. Should subsequent studies strengthen this interpretation, it would illustrate the ability of MDS to expose tacit knowledge.

The plot in chart 2b suggests that there is some intuitive character to the census groupings. For example, if we look at the plot of dimension 1 versus dimension 3, repairer, maintenance mechanic, carpenter, and electrician cluster together. These are all precision, production, craft, and repair occupations. Cook and household cleaner, which represent the service occupations, also appear to form a cluster. The managerial and professional specialty occupations—namely nurse, teacher, and librarian—also seem to be grouped together. And finally, the five examples of technical, sales, and administrative support occupations, word processor, secretary, stock and inventory clerk, cashier and underwriter, also cluster.

Indeed, a cluster analysis of these same similarity data reproduces the groupings observed in chart 2b except that underwriter is grouped with nurse, teacher, and librarian. This is presented in chart 3. The individual jobs are combined into groups and those groups into larger groups until there is only a single group. The four-group solution, which corresponds to the clusters in chart 2b, can be most easily identified by traversing the hierarchy from right to left to the second split.

Although the census groupings have intuitive appeal when viewed in terms of dimensions 1 and 3, their correspondence to people's natural groupings begin to diminish when these are considered in terms of dimensions 1 and 2. If we look again at chart 2a, the clusters in chart 2b begin to spread out along the training dimension. Electrician is much higher on this dimension than maintenance mechanic, for the precision, production, craft, and repair occupations, and underwriter is far from cashier for the technical, sales, and administrative support occupations. It would appear that while training is not explicitly represented in the census codes, it may be important in the way most people conceive of and distinguish jobs. One of the strengths of the scaling technique, is that it can reveal structure, embedded in multiple dimensions, that is not visible in unidimensional representations of the data.

Clearly a procedure like MDS would need to be performed on a larger set, if not the complete set, of jobs in developing any classification system. A larger set of jobs might produce different dimensions, and subjects with different cultural backgrounds might also bring other criteria to the task. Nonetheless, we consider this a first glimpse at how commonsense knowledge of jobs is structured.

Implications

The multidimensional scaling results suggest several ways in which intuitive job classifications might be considered when designing a formal job taxonomy. The first

point is that, in principle, a job could be defined as a collection of coordinates in a multidimensional space. For example, a nurse would be specified by three values indicating that it is a human service occupation, requiring considerable training, and involving work that is partly intellectual, partly physical. In fact a great many studies would need to be carried out before a set of dimensions that span the entire set of jobs could be identified. To the extent that actual values on particular dimensions can be measured objectively, for example, average number of years spent training, it would be important to measure them. Where this is not possible, experts can provide judgments.

An approach like this could help in data collection because it would be relatively straightforward to construct specific probes to collect information about particular dimensions. For example, interviewers could ask a probe question about training upon collecting certain responses. Suppose nurses and physician's aides have the same values on all dimensions except on a training dimension. A specific probe would likely resolve any ambiguity and lead to a more reliable code.[7]

Coders might find it easier to learn to use a classification system if the numbering scheme is meaningful. As it stands, a particular digit in a code is largely *nominal* in that it only distinguishes a particular job from other jobs. The MDS study suggests that the numbers could be *ordinal* so that the difference between them is related to the definitions of the jobs. In chart 2a, for example, nurse is more or less in the middle of the first dimension, presumably because the job involves both manual and cerebral activities. This would be reflected by a mid-range value for the digit corresponding to this dimension. Teacher, in contrast, would receive a more extreme value signifying the predominately intellectual character of the job. Carpenter would receive an extreme value in the opposite direction to indicate the concrete nature of the job.

The multidimensional approach also may help maintain a classification system. By defining jobs as points on orthogonal axes it should be possible to respond to changes in the workforce by shifting the coordinates along the dimension where the change has occurred. Suppose that each job in a classification system had a location on each of our three dimensions. A job like electrician, for example, might migrate toward the low end of the *formal training* dimension as technological advances, such as increased modularization, reduce the expertise required for the job. In principle, the position of this occupation on other dimensions would remain constant (unless change has occurred there as well). The classification system could be updated by adjusting the coordinates for just the *formal training* dimension. Maintenance of this sort should reduce the need to totally revamp the system from time to time.

We have suggested some directions in which new classification systems might go. But until they are subjected to the rigor of actual use and the practical constraints of implementation, the utility of these suggestions is unknown. The next step, therefore, is to begin developing alternative systems, along some of the lines we have suggested, and evaluating the results. At the very least, we will know more than we do now about how to structure occupational information so that it is of maximal value.

Table 1. Stimulus occupations, Census codes, and Census categories

Managerial and professional specialty occupations
Registered nurse (095)
Teacher, elementary school (156)
Librarian (164)
Technical, sales, and administrative support occupations
Underwriter (253)
Cashier (276)
Secretary (313)
Word processor (315)
Stock and inventory clerk (365)
Service occupations
Private household cleaner (407)
Cook (436)
Precision production, craft, and repair occupations
Maintenance mechanic (516,518)
Electrician (533)
Repairer (547)
Carpenter (567)

Table 2. Excerpt of a sample rating booklet

The order of the 91 pairs (rows) was randomly permuted for each subject. Order of jobs in each pair (first or second) was randomized. Subjects entered similarity ratings in slot at left of each pair.

______	Word processor	—	Repairer
______	Secretary	—	Registered nurse
______	Carpenter	—	Electrician
______	Registered nurse	—	Private household cleaner
______	Librarian	—	Secretary
______	Librarian	—	Repairer
______	Teacher, elementary school	—	Stock and inventory clerk
______	Electrician	—	Cook
______	Teacher, elementary school	—	Secretary
______	Underwriter	—	Stock and inventory clerk
______	Word processor	—	Underwriter
______	Librarian	—	Teacher, elementary school
______	Word processor	—	Electrician
______	Librarian	—	Cashier
______	Electrician	—	Underwriter

Cha. 1. MDS solution for OCSP field economists

Dimension 1 (horizontal) is interpreted as an occupation dimension. Dimension 2 (vertical) is interpreted as a levels dimension.

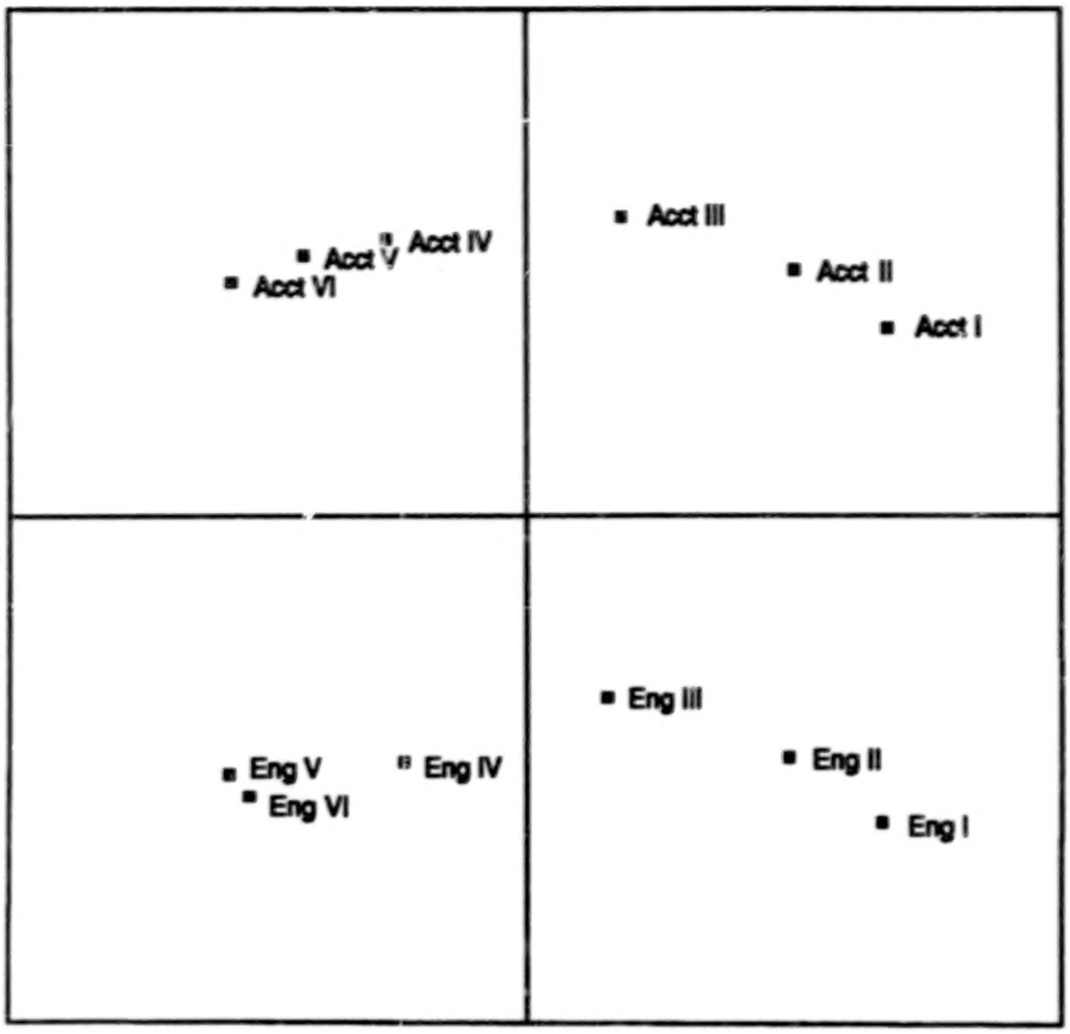


Chart 2a. MDS solution for HRD subjects
Dimension 1 (horizontal) is interpreted as an abstractness of work dimension. Dimension 2 (vertical) is interpreted as a training dimension.

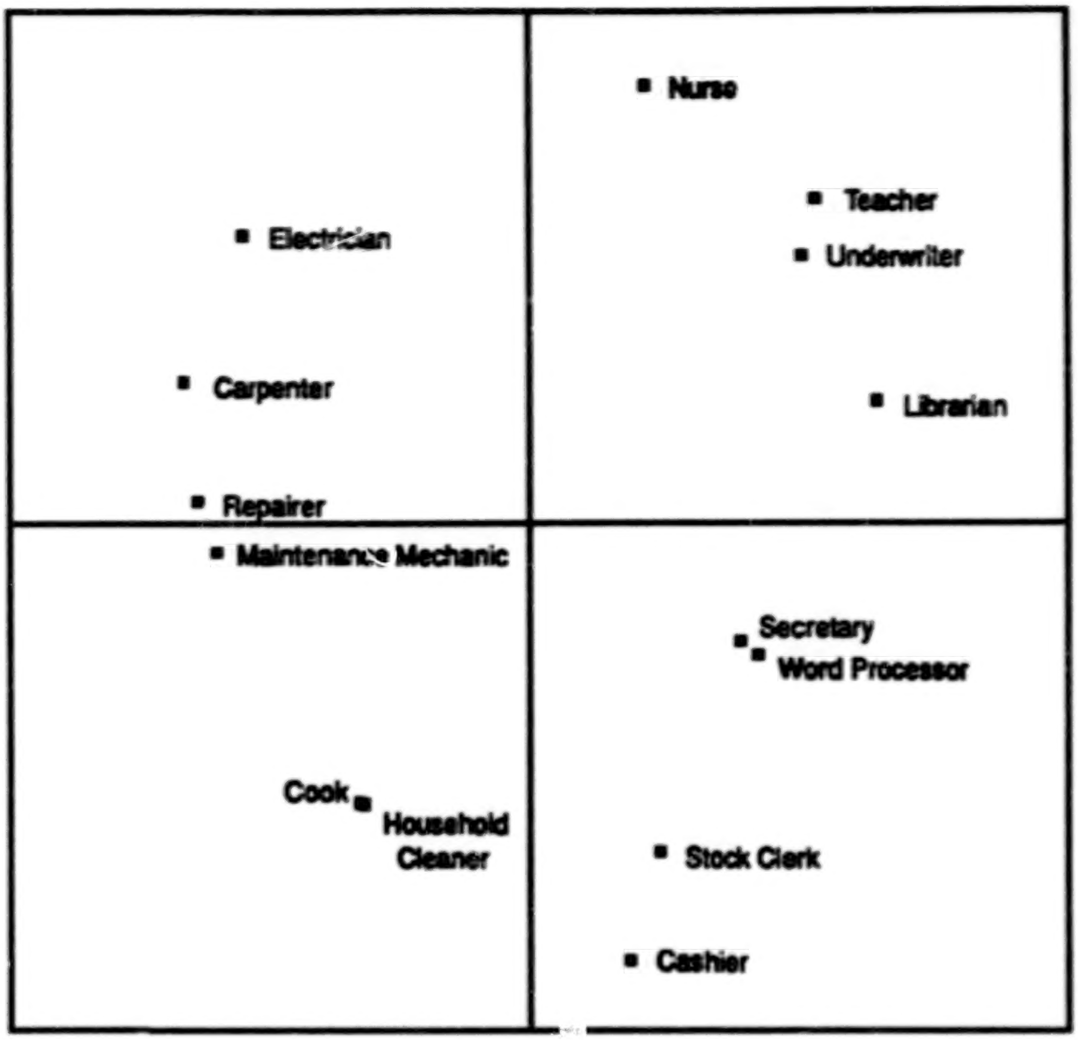


Chart 2b. MDS solution for HRD subjects

Dimension 1 (horizontal) is interpreted as an abstractness of work dimension. Dimension 3 (vertical) is interpreted as a human services dimension.

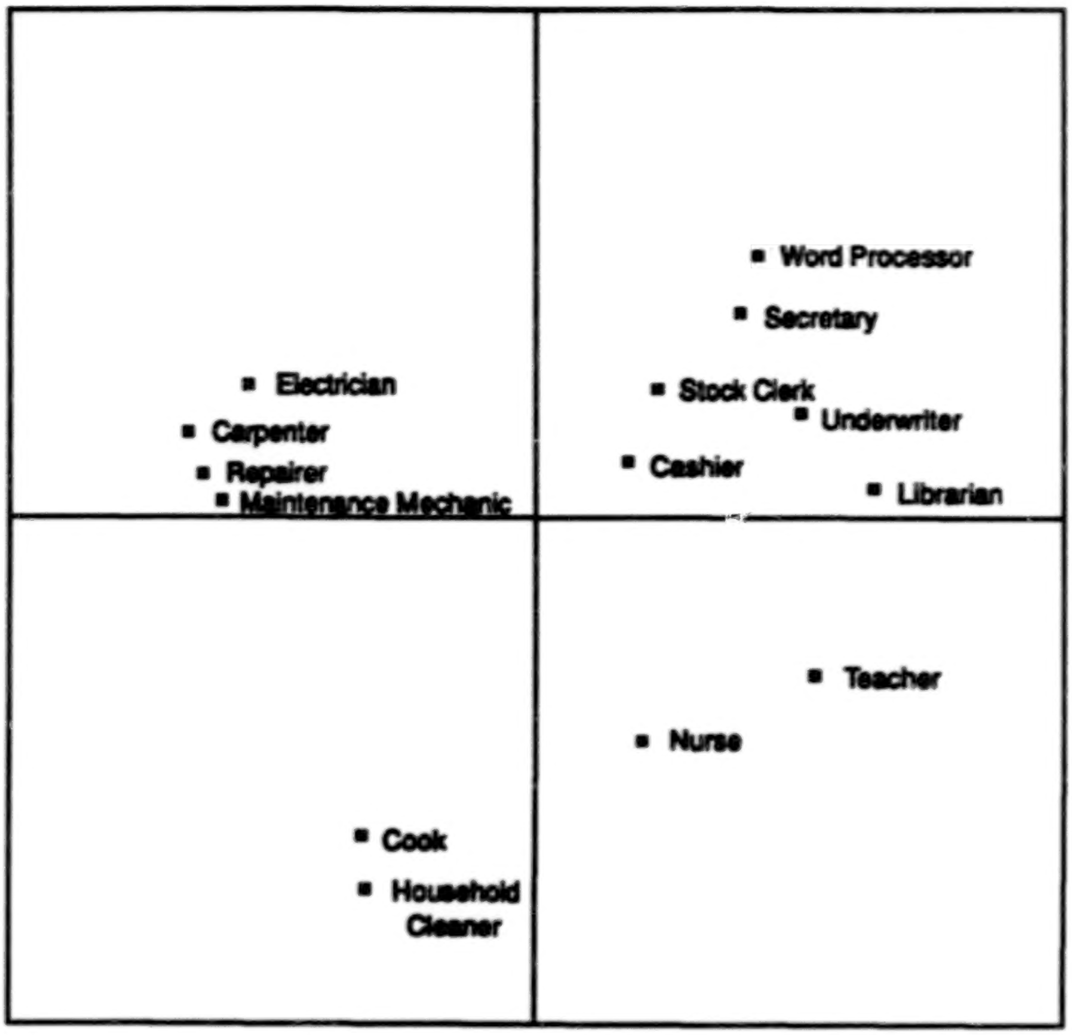
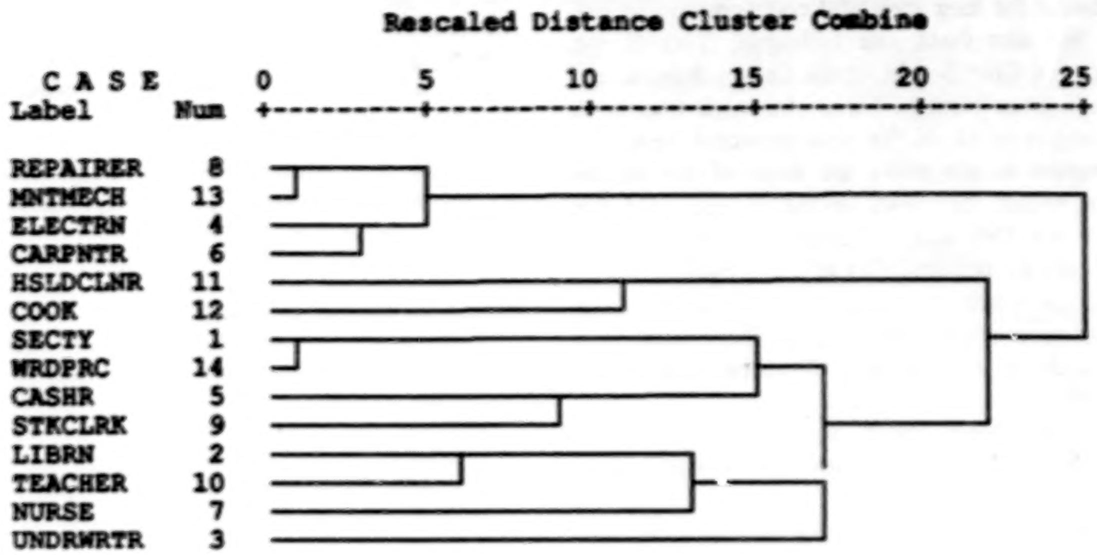


Chart 3. Hierarchical cluster analysis of HRD subjects data

The four-group solution, which can be most easily located by traversing the solution from right to left, corresponds to clusters in Chart 2b except that here, underwriter is combined with librarian, teacher, and nurse.



Notes

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[2] A technique which is often used in conjunction with MDS, hierarchical cluster analysis, has been used in at least one study of occupations (Cornelius, Carron and Collins, 1979).

[3] In its current form, the Census system is derived from the SOC. Crosswalk documents are available from the authors.

[4] As it currently stands the coding is performed after the interview at a separate location.

[5] We used a Euclidean model which is the simplest distance model and requires the fewest assumptions.

[6] The sign of the coordinates is arbitrary for our purposes.

[7] Often respondents answer questions about other members of the household. Just how much is known by proxy respondents about others is a current topic of study (see Bickart, Blair, Menon, and Sudman, 1991). Focused probes of this sort might help respondents report about another.

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Discussion

MARILYN SILVER: Determining the destination or the goal of the new occupational classification system is the most important issue to keep in mind. What should be the goal or the destination of the new SOC? In a context of the changing world of work and the dawning of a new century, we must reconsider what we expect of a new SOC.

As some of the experts have noted in their papers, the 1980 edition of the SOC was described as being designed for use in statistical analysis and presentation of data about occupations. It was not developed for any particular programmatic use.

Thus, the developers of the old SOC focused on statistical applications rather than on program users. Is this an appropriate approach today? Much of the debate suggests otherwise. One question that I hear is, "Should the new SOC have a purpose, a goal or a destination that more closely aligns itself with workforce development concerns such as helping people find jobs, upgrade their skills, and reenter the workforce?"

This is the type of question that should be addressed. The authors of these papers are aware that technology and international competition are changing the workplace. The new workplace is characterized by fast-paced product cycles, rapid changes in technology, and increased interest in quality and service.

To meet these changes, new business arrangements have evolved that encourage faster and more creative action, increased flexibility, and closer partnerships between employees and customers. Global competition has also increased the pressure for performance, resulting in more flexible and adaptable workforces that value teamwork over individual efforts and networks and alliances over rigid hierarchies.

Newly streamlined companies decentralize responsibility and create greater employee involvement in all levels. In short, these new workplaces demand new technologies, new workplace structures, and new skills. Some believe that we also need new or reinvented occupational classification systems to adequately capture and transmit the information about today's workers and workplaces to our users.

A recommendation made by the Advisory Panel for the Dictionary of Occupational Titles would have a future DOT and SOC become technically and conceptually compatible, even moving toward a single structure.

The bottom line is that, if occupational classification systems are to be useful to educators, employers, counselors, and workers, as well as statistical users, they must capture new information while providing greater access and flexibility.

DANIEL WEINBERG: (For Dan Flaming) There were two topics that have come up earlier that you didn't mention at all. I'd like your perspective. One was the importance of historical continuity. Of course, changing the way you suggested would destroy that continuity.

Second, the demand side of the labor market, to follow up on the alternatives that Jack Triplett pointed out for the product market, the supply side and the demand side. You've talked about labor supply almost exclusively. What about the needs of industry? How would you satisfy those in your system?

DAN FLAMING: I think that in terms of continuity over time, we can take a page from the SIC in which periodic revisions of codes and classifications are commonplace. It's certainly a field in which historical analysis is at least as important.

The judgment is made in the case of the SIC that the relevance and accuracy of classifications is the most important consideration, and then crosswalks between all the new systems are provided. So I would suggest that it could also be applied to revisions in occupational classifications, that even though you lose something with revision, you can recapture some of it with crosswalks and that accuracy is paramount.

In terms of looking at demand as well as supply, I believe the example near the end of the paper about the integration of datasets and displaying them, for example, in GIS (Geographic Information System) format, could provide a powerful rich source of data about what actually occurs in the labor market by occupation.

One could see not only what levels of employment there were in given occupations, but what the stability of employment was, what the earning trends over time are, what the promotional or lattice possibilities are. The result could be very informative to help differentiate occupations in which workers get churned as opposed to occupations in which demand is relatively stable and jobs are relatively stable.

So I think the integration of databases would help accomplish quite a bit of that.

JACK TRIPLETT: (For Dan Flaming) It's a very interesting paper, and I want to focus on something that was perhaps not in your major objective, but intrigued me.

If I understood the early part of the paper correctly, you were saying—I think the same comment was made this morning in Odessa Dubinsky's remarks—that the SOC had originally been set up for analytic purposes and by analytic people without enough attention to data development for programmatic purposes, and you would like to see data that was more useful for programmatic purposes.

I come at this from another way, because basically I'm an economist. I was interested in the analytic data,

and I was interested in labor market analysis. Frankly, my impression is that these data are not very much used for analysis, and are not used, certainly, very much by economists for analysis.

So if it was set up for analysis, I don't think it's been greatly used for that purpose. I always thought it was the opposite. I always thought it was a system that had been set up mostly for programmatic reasons and, therefore, that was the reason it wasn't useful for analytic purposes.

I think it may be useful to think about that in the context of this conference, because I think you and I agree that one should construct a data program in order to provide data that are useful. I have a feeling that some of the proposals you're making would also make the data more useful for analytic purposes.

So I'm not so sure that this tug of war between programmatic use and analytic use, which is often a real one in the production of labor market data, is the issue here. We may be dealing with an animal that isn't set up now to be useful for either purpose, and I'd like to hear some other people's responses to that.

DAN FLAMING: I'd be interested in hearing other people's responses, too. I could give you my response, which is that occupational information would seem to me to be at the heart of issues that are central to the national agenda.

We have, really, no national priority that's more important than people being employed. We gradually, since the War on Poverty, have let go by the wayside virtually all ways of enabling people to be financially self-sufficient except by being employed.

These data are the data that support strategic planning toward that end, and for something as important as this information, I'm often struck by how remarkably little excitement there is about it and how remarkably little use and awareness there is of this information.

Our sense is that many of the people concerned with these problems are not very aware of even DOT data, much less SOC data, and that a more powerful system with the ability to integrate more information elements would create new kinds of excitement and greatly enlarge the body of users and that, as a result, as I think you said, you would have information that was more powerful both for programmatic and analytic or research purposes.

ARDEN FORREY: What I'm asking, follows up on the questions that probed the programmatic and the analytic use of the attributes about a given occupation, from the standpoint of health care, it also is used for programmatic purposes, namely, delivery of health care, but also for resource management, which is an analytic function.

You mentioned the development of skills attributes for occupations. My question is: Is there a standardized terminology for skills that we can link to the terms for occupation?

DAN FLAMING: The easiest thing to do is to slide into a substitution of training and education level for skill. The actual development of a generic skill definition and identification system is the subject of some papers that have been commissioned by the BLS and is a massive undertaking.

It's something that does not exist now, and the methodology by which to do it is not clear, although there is some pretty good thinking about how to do it. It's clearly an expensive process and one in which new tools and scales have to be developed, but for these problems of skill transference and movement in the labor market, it's the key piece of missing information that we don't have right now.

I would expect that the DOL staff, for example, Donna Dye, might be able to refer you to some papers on that topic.

MARILYN SILVER: As a part of the report for the Advisory Panel for the Dictionary of Occupational Titles, there is a list of references in the back. We have three notebooks full of papers that deal, some of them, with those issues, and the Advisory Panel put out a content model trying to describe the kinds of things that would need to be developed in this area.

DONNA DYE: I address some of the issues with respect to an approach toward a skills language in my paper. I could ask the same question, "What do we mean by skills?", and give a definition of that. That will be one of the more problematic things to deal with and for us to decide on what skill is.

Some of the international community here will be able to help us explore that, too. I know Margaret Roberts has looked at that, and some other people here have looked at that, and perhaps we'll gain some insights on that.

MARILYN SILVER: The last point that you were making, Joel—the difference between collecting data from households and from employers, and your comment that your SIC, the new ideal, could be used to do both. Do you want to just say a word or two about that?

JOEL POPKIN: Well, it seems to me that the questions that are asked in the household surveys will end up being a lot of the things that would play into the basic classification. I think the potential incompatibility is that the answers that some people give you will really be answers to the human capital question and not to the actual terms of their employment.

I think that's the potential incompatibility, and you can think of extensions of questions which might be able to get at that, just by asking some of those. There

are surveys, I believe, where they ask about using these skills in your job. There are a couple of math and science surveys on the CPS that just did that.

So I think they can be blended. I'm not responding, though, to the question of whether the confidentiality requirements of the U.S. Government will allow the linking, and there are other problems in the linking.

A household will only get you into one establishment. There are the problems of symmetry in counts in doing an actual linking.

JAMES SCOVILLE: Both the Economic Roundtable paper with its occasional references to job content and Joel Popkin's paper with its references to a matrix of types of work, types of skill, and levels of work or levels of skill, leads me to want to expand briefly on the subject.

In some sense, what I wanted to stand up and say is there's good news and bad news. The good news is that some of this stuff has been undertaken before. I'll come back to why I think this has happened.

Back in the mid-1960's I proposed an experimental implementation using existing Census data of a job content by level of job content, a job family by level of job content matrix, including principles about lines of promotion, employer substitutability, and worker transferability.

As part of this project, I came up with a fairly firm grounding in microeconomics of employment. This was applied to a wide range of questions including a national comparison of job content between the United States and Canada. It was experimental, limited to what a private citizen can do. The extension of this idea in an international conference to the concerns of less developed countries, can be applied to the provincial level in Ontario to plan training requirements for that province, and it can be applied to a local labor market analysis for a model cities area in the United States.

That's the good news. This thing has been tried and, at least to its author's satisfaction, worked reasonably well. Now the bad news is, in some sense, we're reinventing the wheel in part because the work noticed was done from 1967 through 1985, including a couple of, I think, fairly well known books and, oddly enough, most of it, two books in particular, were supported by Department of Labor research funds.

So they're paying for it twice. I don't want to dwell on that. What I want to dwell on is an interesting thing, and the lesson of all this, to me, is that this field has lain fallow so long. This field essentially shrank and died. We lost all the momentum that we had going towards the end of the 1980's.

Most pointedly, I think, during that time period our international colleagues have only underscored how dead in the water we've been by getting, I think, a fair ways ahead of us.

ROBERT GASPEROW: (For Seymour Wolfbein) You've come up with an occupational classification system that could be consistent with an SIC structure. I also want to thank you for—I thought I was going to get up and talk about a subject that had not come up today, but you've brought it up indirectly, and it has to do with occupational definitions for regulatory purposes.

Increasingly, hiring, firing, promotion, and evaluation have become a regulatory activity in this country, and what we're finding is that SOC and related occupational descriptions are very much being used by employers when it comes to ADA, Americans with Disabilities Act.

As we talked about uses of all the data today, no one has mentioned that, and I would just pass it on to those that are looking for revisions and looking how the data are used. It's considered to be an objective and authoritative source for benchmarking, what you're doing in your own company. As a positive way of looking at it, and as a defensive way, it's a good way to keep out of legal disputes by benchmarking against it.

I think the trend definitely has to be that there is going to be more of that in the future than less.

MARILYN SILVER: I hope that what we've accomplished has gone a long way toward shedding some light on areas of ignorance regarding a future SOC and that we're going to be able to help BLS move forward in developing their plans.

BART BAKKER (For Daniel Krymkowski) If you want to base your classification on skills, that would implicate that occupations which require similar skills should be aggregated in the same occupational group or occupational class. If you want to indicate this similarity of skills by career mobility, I think there are several problems. I'll just mention one. The most important is that there are other factors than skills, such as age, sex, health, ethnicity which determine these career mobility patterns. These variables distort the career mobility pattern. I would like to have your comment on that.

DANIEL KRYMKOWSKI: You're absolutely right that career mobility patterns and other types of mobility patterns would have to be explained by a whole host of variables and not just similarities in the occupations per se. I would say that it's probably very difficult to have lots of mobility between two occupations if the skill levels aren't somewhat compatible. But like you said, people can be excluded based on other criteria. So, I wouldn't advocate mobility as the only way of going about looking at an occupational classification. But I think in conjunction with other ways it can provide you with good and interesting information.

SEYMOUR WOLFBEIN: Just a very fast comment. I thought the papers were excellent, if I may say so, and really on the mark.

I'd like to make a point concerning our young colleague from Vermont on the Blau-Duncan. I think you might be interested to know that in our research, which is almost completely from the consumer side, we found very substantial evidence of what you were pointing out among practically all of the people we transacted with. Perhaps most obviously, it's the relatively strong evidence found among the very young, who are perhaps still affected by parental guidance. But even among people who were older, and perhaps unemployed, they showed a very substantial history of the importance of what we're calling intergenerational mobility.

I'm sorry that we haven't kept count of this, but you've inspired us now to want to get back to see if we cannot indeed actually keep count of this by age and sex and so on of the various respondents. So, I think you were really on the mark and I appreciate the entire panel.

DONNA DYE: I wanted to share some information with Mr. Conrad and perhaps raise a question.

One of the things that we have noticed in the past few years in reviewing the Dictionary of Occupational Titles is that there is a very serious problem with the whole issue of scaling. Our raters rate the various attributes and components of the DOT based on various scales that we have developed over the years. One of the things that we have found is that while these ratings may be reliable in the sense that you can depend that the raters will find the same thing over and over again, they may not be valid when tested with empirical evidence.

So, the question that occurs to me is why would you introduce an intuitive approach to occupational classification wherein there are some problems, or if you want to introduce an intuitive approach, how would you resolve some of the tensions between reliability and validity?

FREDERICK CONRAD: Yes, that's a great point. My sense is that you would want to carefully explore the accuracy of these intuitions. When you have faith that they are accurate, are capturing the construct you have in mind, I think they're valuable to implement because they make the system that much easier to use, or at least to learn how to use, that much closer to the way one already thinks. So, I agree that there's a potential problem with validity. I think the advantage is ease of learning and presumably accuracy in using the system.

THOMAS SCOPP: Fred gave credit to some of us at the Census Bureau for helping him. He didn't say that we gave him a lot of heat because in the beginning we weren't quite sure what this guy was doing comparing electricians to nurses. But I was pleased to see the result and I agree that as we deliberate about what is the ideal classification, we really need to keep two things in mind. The comment was made earlier we need to be careful of a classification system that's too intuitive and doesn't have statistical reliability. I think we also have to be careful of coming up with a classification based on a very sophisticated statistical model that in the end doesn't make sense in the real world.

So, it's a balance here that we have to find, to come up with a classification system that makes sense, that matches reality, the world of work as we know it, but also does have statistical reliability as well.

Module 3. User Needs and Different Experiences with Different Occupational Classification Systems

Introduction

What are user needs and experiences with occupational classification systems? This section addresses this question. Alan Moss, drawing on principles of total quality management, describes "consumer criteria" for the next SOC. Robert Korte provides an overview of a project to measure basic workplace competencies across occupations. James Van Erden describes recent joint efforts by the Departments of Labor and Education to facilitate the development of occupational skill standards and the importance of linking these initiatives with a new occupational classification structure.

Consumer Criteria for the Next Standard Occupational Classification System

Alan L. Moss, Ph. D.
Employment Standards Administration

Introduction

In recent years, Quality Management has reinforced the age-old adage that the customer is always right. In fact, the first rule of the Quality Model adopted by my agency, the Wage and Hour Division, pays homage to the customer:

> "Whether inside Wage and Hour or outside, the people who receive products, services, or information from any Wage and Hour process are its customers. Their needs and requirements are legitimate; their needs become drivers. It is they, individually and each time, who define quality and judge the quality of our service." [1]

Success in any endeavor is most appropriately measured by the consumer. Whether the subject is prevailing wage programs, television shows, races for political office, or occupational classification systems, pleasing the consumer should be the principle objective.

In market settings, the degree to which a product or service is accepted often determines the fate of the producer. A popular television show receives high ratings and is renewed for next season; an unpopular offering is canceled. The political candidate who has impressed his or her constituency is reelected; the candidate who has disappointed the voters is sent packing. With competition, those who consistently neglect consumer criteria cease to exist. Without competition, organizations may fail to meet customer needs and continue for long periods of time. In particular, government initiatives can fall short of consumer satisfaction, while escaping the scrutiny of the market.

Of course, no one wants to ignore the quality needs of those for whom a product or service is intended. But human nature dictates that the level of effort made often corresponds to positive and negative forces of reward and punishment.

Because of this phenomenon, and critical public feedback on bureaucracy in general, recent U.S. Administrations have used various management concepts and tools to provide government with added incentives to meet customer needs.[2] Management by objective, zero-based budgeting, total quality management, and now reinventing government, have been encouraged to apply some of the market's discipline to government operations. Through such means, and appropriate levels of Federal investments, it is hoped that government might improve its level of service.

The purpose of this paper is to help bring some consumerism to the project to develop the next Standard Occupational Classification System. Specifically, this paper seeks to offer: 1) A process for establishing consumer criteria; 2) a description of the customer environment; and 3) some ideas for satisfying consumer needs.

Before proceeding with that agenda, it is necessary to address the scope of this research. This is required because consumers do not evaluate individual classification and information tools in a vacuum. Instead, they judge the quality of a product by the overall contribution it makes. Often, that contribution does not depend on the technical validity of the resource itself, but on the information or service accessed that utilizes the subject tool.

For example, the "*Standard Occupational Classification (SOC) Manual*" may identify related occupations being considered by a high school student. If no current definitions of those occupations are readily available, the value of the SOC is constrained. Similarly, a job service staffer may have utilized the *Dictionary of Occupational Titles* (DOT) to identify an occupation suitable for a jobseeker. If no current openings in that occupation are listed with that job service office, consumer satisfaction is frustrated.

While criteria for a labor market information or job placement system may be beyond the scope of this paper, and this conference, the quality of those resources color customer perceptions of individual tools such as the SOC and the DOT. In fact, it is the consumer's ultimate objective that forms the basis for customer criteria. Therefore, while this conference focuses on a Standard Occupational Classification system, if we are truly interested in meeting customer needs, we do not have the luxury of ignoring the context in which a revised system must operate.

A Process to Establish Consumer Criteria [3]

Consumer criteria for the next Standard Occupational Classification system might be established through a three-step process. Step 1 requires identification of cus-

tomers; step 2 determines customer needs; and step 3 translates customer needs into terms with which providers may deal.

Before we are able to discover consumer criteria, we must develop a comprehensive listing of who those consumers are. This may not be as easy as one might think. For example, we are told to identify customers by following the product. But if you ask for a listing of those who purchased the *SOC Manual*, you find that no records are kept. Another complication concerns those who are potential users but have *not* used a standard occupational classification system. If a representative sample of these individuals can be developed, they might be able to identify criteria which, if met, would lead to expanded SOC applications.

One means of identifying customers is to form logical categories from which they may be accessed. For example, some customers may be felt to be of different levels of importance.

Many of those attending this conference may be considered part of a group often labeled the "vital few." This constituency has expert knowledge of the subject matter—in this case, occupational classification systems—and will exert significant influence in providing insight into consumer needs. Their approval will be required if a new system is to get past the many hurtles that must be jumped.

The "useful many" is a group of important customers who obtain a product for personal use. Professionals who counsel or place clients, develop labor market information, conduct planning and research, or practice human resource management would fall into this category. Because of their extensive experience, such users are well qualified to offer advice regarding consumer criteria to be adopted.

The "workforce" is a third category of consumer expert. In this case, those who practice occupational analysis, and have extensive "residence" in preparing the tools and products of occupational classification obtain a special knowledge concerning the quality requirements of an occupational classification system. Tapping such expertise should be a valuable asset in developing consumer criteria.

Another way of categorizing customers is by use. In the case of occupational classification systems, four groups of customers might be formed based on function: Processors, merchants, ultimate users, and the public.

Processors would be those who view an occupational classification system as input to their process. For example, those developing academic curriculums, counselors, developers of labor market information, and Job Service placement/immigration staff all apply an occupational classification system in preparing products or providing a service. Because their output benefits the ultimate consumer, they are a logical source of customer criteria information.

Merchants, such as the Superintendent of Documents, and numerous private sector companies, invest in using and reproducing occupational classification systems for sale. Because they are oriented to and dependent on the market, they should possess special knowledge of consumer preference.

Ultimate users, such as students, jobseekers, and employers, typically consume the information product or service that uses an occupational classification system, and may on occasion also use such systems directly. These consumers often represent the primary reason for a product or service, and therefore must be recognized as an important source of information.

And finally, the public may be impacted by an occupational classification system in terms of improved functioning of the labor market. For example, linkage of occupational classification and labor market information systems might result in enhanced career decision-making, reduced unemployment, and overall economic benefits that reward the public in general.

Once all legitimate customers are identified, step 2 determines customer needs. However, before techniques for discovering customer needs are reviewed, certain pitfalls should be noted and formats for needs display described.

First, perceived needs do not always represent real needs. For example, guidance counselors may perceive a need for improved information on occupational education and training requirements. But experimentation may prove that learning to use the GED/SVP features of the *Dictionary of Occupational Titles* might satisfy that perceived need.

Second, "cultural" needs, which are rarely stated openly, may be behind expressed requirements, especially those of internal customers. For example, some occupational analysts may claim that automating their work process would reduce the accuracy of information developed on duties and tasks. Is this need—for maintaining current manual processes—based on fact or fear of computerization?

Third, some expressed needs may be traceable to unintended use. A counselor may request improvement in the quality of a career ladder scheme based on summation of DOT codes, when, in fact, no such scheme has been devised. However, while one may discount the criticism of a nonexistent tool, one would not ignore the inherent need embodied in the complaint.

The display of needs information is significant since customer satisfaction often depends on meeting primary, secondary, and tertiary needs. Without accommodation of such requirements the consumer remains stymied. For relatively simple needs chains, graphic models may present a pyramid of needs to form an accurate picture of the consumer challenge. Figure 1, below, depicts the needs for effective career exploration, as expressed by

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a few high school students at Lake Braddock High School in Burke, Virginia:

Figure 1: Pyramid of needs for career exploration

Primary need:
Career exploration
Secondary needs:
Integrate in curriculum custom to H.S. students current/local
Tertiary needs:
Videos/personal contact/work experience

Note that these students felt little need for written occupational definitions or statistical information, unless they were expressed in connection with visual and personal presentations. More complex needs configurations may be captured on spread sheet programs, which accommodate numerous need statements with ease.

To discover customer needs, one may: 1) Be a customer; 2) communicate with customers; or 3) simulate customer use of a product or service.

Many of us have been customers of occupational classification systems. We have developed occupational surveys, analyzed employment data by occupation, or matched job applicants with available openings through the use of specific occupational coding schemes. This direct customer experience may form valuable first-hand input to the development of consumer criteria. In addition, such experience may be expanded through the design and conduct of training courses that expose staff to direct user contact. For example, occupational analysts might be trained to assist guidance staff in placing job applicants or assisting counselors in career decision-making activities with students. Greater knowledge of and sensitivity to consumer criteria would be a likely result.

The most common means of discovering customer needs is through communications with consumers. Negative communications often are initiated by the customer, who complains that a product or service has missed the mark. Organizations typically view such communications very seriously and attempt to take steps to rectify the problem and retain the customer. For example, I assume that customer complaints concerning the date of last revision of the SOC *Manual* played some role in instigating this conference.

Positive communications must be sought by studying customer behavior, or through market research keyed to the type of customer or non-customer being targeted. Conferences, and sample surveys using personal contact, telephone calls, questionnaires, and consumer panels may serve to determine consumer criteria. At a minimum, we would use such tools to find out key characteristics of a standard occupational classification system, and the cost to the customer of quality deficiencies.

A third means of determining customer needs is to simulate use of a standard occupational classification system. A graduate course I teach at the University of Virginia's Falls Church campus has the students attempt to solve certain career problems of fictitious individuals. Spread out before them are most of the national and many local occupational and labor market information resources that should address the customers' needs. It isn't long before most students learn the difficult lessons of systems that don't fit together, dated information, and inadequate geographic specificity.

After identifying customers and their needs, the third step in setting consumer criteria involves translation of those needs into terms that are relevant to providers of the product or service. When I questioned those Virginia high school students about how timely job descriptions needed to be, one of the girls volunteered that when accompanying pictures revealed hair styles that were out of date, she dismissed all of the associated information. She was expressing customer criteria in her own language.

We must translate her opinion into terms with which we can deal. One means of accomplishing this would be to provide the customer with standard measurements from which to select update requirements, such as update every year, 2 years, etc.

Another need recently expressed, this time by staff of the Virginia Job Service, was for an occupational classification system that would facilitate job matching by broad industry groups. Suggesting standard specifications, such as use of the *Standard Industrial Classification Manual* to designate the industries most often employing individuals in specific occupations, makes such a recommendation easier to visualize.

The process described here is long and complex. Carrying it through will be a costly and difficult endeavor. However, if development of a U.S. Standard Occupational Classification system were being bankrolled by one of today's lean and mean corporate entities, with future profits dependent on identification and satisfaction of consumer criteria, there would be no doubt that a process such as this would be conducted. Under the precepts of "reinventing government," and given today's consumer environment, our need to accurately define consumer criteria seems no less important.

The consumer environment

Understanding the environment in which consumers must function provides additional information on the content and priority of required criteria. This calls for a form of strategic planning to describe the setting in which a standard occupational classification system will be applied:

> "A critical element in that planning is identifying those powerful forces and examining their impact on customers' needs and their priorities. In the absence of such strategic planning, we overlook essential early warning and thereby encounter unpleasant surprises and crisis situations, with resulting urgencies, wastes, and irritations." [4]

In recent years, it has been no secret that the job market has become a less friendly place. Specifically, three agents of change have acted to make career decisions and job search strategies more and more important: 1) Emergence of the world economy; 2) reduced services and job security offered by government and unions; and 3) trends in demographics, family life, and immigration.

With national economic borders disintegrating, U.S. corporations are facing increased competition from producers around the globe. To survive in this environment, employers have responded with strategies to raise levels of quality and efficiency. Seeking to free themselves from costly "overhead," U.S. corporations have jettisoned thousands of middle managers and blue-collar production workers.

The large pyramid of the American corporation is being replaced by cost conscience central offices who are likely to get the job accomplished through part-time or temporary workers (who typically receive no fringe benefits), contractors, or foreign affiliates. As a result, once comfortable internal labor markets, in which employees pledged long-term service in return for the safety of institutional rules, have been replaced by external markets.

Such markets are characterized by all the insecurities suffered when the wage is the only bond tying worker and employer together. Distinct entry level jobs, specific job content, identifiable career ladders, and seniority-based upward mobility are giving way to less certain relationships. In effect, for many industries, Solow's "Labor Market As A Social Institution" has reverted to its original form.[5] While some American workers have been exposed to Total Quality Management (TQM) to spur continuous improvement, TQM also can be an unsettling influence. For example, recent studies reveal that TQM shifts workplace organization from a vertical array of positions and functions to horizontal structures. At the same time, specific job duties give way to a broad range of team activities aimed at customer satisfaction.[6] This has been accompanied by rapid advances in technology that alter production processes and place ever-changing skill requirements on employees.

A second factor in transforming the U.S. labor market has been reduced institutional protection, as provided by government services and union security. To a large extent, these losses to the American worker can be traced to anti-government/anti-union sentiments that emerged during the late 1970's and 1980's.

In recent decades, significant reductions in Federal budget allocations for guidance, job placement, training, and labor market information have decreased services. In addition, decentralization of responsibilities has discouraged the maintenance of minimum/standard services and products aimed at meeting the needs of specific consumer groups.[7]

Staffing for the *Dictionary of Occupational Titles* is a good example. In 1976, there were 10 Occupational Field Centers with about 100 Field Center employees, and a National Office DOT staff of close to 30 professionals. Today, there are just 5 Field Centers, 30 Field Center staff, and a National Office DOT staff of 1.[8]

While government services have been cut, reduced worker protections also have been derived from the falling proportion of the workforce covered by union collective bargaining agreements. In 1955, almost 25 percent of U.S. workers were union members; today, just 16 percent benefit from a union contract.[9] Reduced union coverage means reduced worker compensation, loss of regular raises through negotiated escalator clauses, elimination of rules governing entry and conditions of work, and absence of negotiations to resolve employee complaints.

The labor market environment also has been made more difficult by demographics, changed family lifestyle, and immigration. With regard to demographics, the fastest growing groups are those most in need of intensive educational and training opportunities. Between 1990 and 2005, new labor force entrants will be more likely to be women, blacks, Hispanics, and Asians, and less likely to be white males.[10]

More than half of all black families are single parent units, with family members often employed in secondary labor markets.[11] Inner city residents frequently rely on public assistance and contend with poor living conditions and crime. As a result, the world of work is viewed as a hostile environment, offering no escape.

While the average American family fares better than most urban dwellers, they still suffer from a new era of "fast food" living. With fathers and mothers both holding down full-time jobs, and children involved in numerous activities (to keep up with the competition for college), there's simply no time for contemplation of the world of work.

Ironically, while many families place strong emphasis on selecting the right college, similar effort to scrutinize the vast array of occupations that can offer employment after college is often left to a few career days and book reports. However, even if parents attempted to orient their children to the world of work, this task has been greatly complicated by technological advances which have made many jobs and the preparation they require only understandable by those currently involved in performing or studying such work.

Finally, increased immigration has placed more foreign workers in U.S. labor markets. During the decade of the 1980's, an average of 7.3 million immigrants lived in the United States, more than double the number in the decade of the 1960's.[12] In 1990, over 1.5 million immigrants entered the United States, almost triple the 1980 total.[13] At the same time, the Immigration Act of 1990, specifically addressing employer needs for

skilled employees, increased annual quotas for employment related immigration by 500,000, to be phased in during the period 1991–96.[14]

Given our 128 million worker labor force, these developments may be characterized as insignificant. Also, many immigrants offer skills and abilities in short supply. However, for certain occupations and geographic areas, the added competition may deny domestic workers opportunities that otherwise might have been theirs.

In summary, the environment in which the new Standard Occupational Classification system is to fit is one that requires universal and intensive use of occupational information. At least for the foreseeable future, the days of completing a non-directed college program and waltzing into a well-paying, secure professional job appear to be over. Similarly, completing a general high school program, and then moving into a local, high-wage manufacturing plant also appears remote.

SOC consumer criteria

The foreseeable future appears to offer continued formation of the world economy; increased competition for jobs, many of which will become less secure; accelerated technological progress and changing occupational skill requirements; reduced Federal budgets and job-related services; and lack of public focus and understanding of the labor market in general, and job requirements in particular. For the American worker, these developments put a premium on tools that promote informed career decision-making and effective job search techniques.

If the labor market is the environment in which we seek, accept, and retain employment, occupational classification systems form the "address books" from which we choose our "place" of work. To survive in today's difficult job market, one must select an occupation carefully, making sure that it: 1) Fits one's personality; 2) requires skills and abilities that can be obtained; 3) offers a reasonable number of openings; and 4) provides an appropriate level of income and a healthful and secure workplace. A standard occupational classification system that meets a broad range of customer needs could play a central role in helping students, jobseekers, and employers achieve their employment objectives.

Due to the time and level of resources allocated for this paper, and the complexity of the task, it has not been feasible to develop a comprehensive description of consumer criteria for the next Standard Occupational Classification system. Therefore, the paper has focused on description of a process through which such criteria may be developed, and the environment in which the system is to fit. However, in developing such information, certain consumer criteria have come to light. While a process such as that described in the initial section of this paper should be used to verify and expand the criteria listed below, they appear to form reasonable candidates for consideration.

Scope

Cover all occupations found in the U.S. economy. It is not possible always to know how significant a given occupation may become to the economy. Also, individuals should have the opportunity to review all occupational choices.

Include occupations unique to other nations' economies when it is likely that such work will soon be found in the U.S. Why not give students/workers an opportunity to see what occupations may be coming to the United States? This also may help employers in terms of having a workforce ready for new occupational specialties.

Content

Provide standard occupational titles and definitions, including job duties and tasks, products produced/services provided, physical requirements, education (academic curriculum) and training requirements, industry(ies) employing (SIC), usual career ladders and transferability to other occupations. Given the difficult labor market environment, such information would be the basic minimum required from an occupational classification system.

Furnish impact information from new or anticipated technological innovations. Given the rapid pace of technological advancement expected, such information would provide an opportunity to plan for the future.

Specificity/styles

Within one unified system, offer multiple levels of detail that effectively accommodate the special needs of counselors, placement specialists, labor market information staff, immigration personnel, and other "processors." For example, the Occupational Employment Statistics (OES) program would require a fairly general description for employment and projections purposes, while guidance counselors require very detailed presentations.

Provide definitions in various styles, keyed to ultimate users, such as students, jobseekers, and employers. Dry, factual definitions tend to "turn off" young audiences who might be captivated by a more appropriate genre.

Linkage/arrangements

Provide universal linkage to all major statistical, job placement, training, and education programs. With all of these programs utilizing the same Standard Occupational Classification system, consumers will be able to consult much statistical information utilizing comparable occupational definitions.

Provide for the availability of occupational groupings based upon such variables as: Required skills, industry

(SIC) settings, levels of compensation, academic programs, and projected employment growth. This capability might be available through automated/electronic systems that furnish instant information by criteria specified by the consumer; that is, list all those professional occupations in the electronics industry with average annual compensation over $40,000. Execution of another command might then offer relevant local information, such as openings at local Job Service offices.

Presentation

SOC information should be integrated into consumer processes, such as to students through academic offerings. To survive in America's demanding labor market, students must make informed occupational choices. Separate career information sessions often are bypassed for courses that assist students to enter college. Less ambitious students often take just what they need to get by. Under this criteria, basic courses would include a unit on occupations especially reliant on the curriculum (English, mathematics, etc.).

SOC information, and related statistical data, should be offered in multi-media presentations, including hard-copy formats, floppy disk and CD ROM, on-line/interactive information systems, bulletin boards, and video. The important criteria are that the medium is easily accessible to the user, and the presentation is keyed to consumer preference. For example, a job description communicated through a personalized video, that could be accessed in English class as part of that curriculum, could be ideal for a high school sophomore.

Maintain the timeliness of SOC and related information. The day of updating volumes of occupational definitions once every 5 or 10 years, or even every year should come to an end. Given the rapid pace of technological change, and consumer sensitivity to dated material, a process should be devised to provide for updates as soon as the need is known.

Notes

[1] *Wage and Hour Quality Model, Quality Primer*, Third Edition, S.R. Evanoff and David Leslie, 1990, p. 3.

[2] An interesting commentary on the public's view of government bureaucracy is provided in *The State of Public Bureaucracy*, Larry B. Hill, Editor, M.E. Sharpe, Inc., New York, 1992.

[3] The framework used in this section is from *Juran On Planning For Quality*, J.M. Juran, The Free Press, New York, 1988, Chapters 1–4.

[4] Ibid., p. 58.

[5] See *The Labor Market as a Social Institution*, Robert Solow, Cambridge, Mass.: Basil Blackwell, 1990.

[6] See "Aligning Human Resource Processes with Total Quality," Jeannie Coyle, *Employment Relations Today*, 1991, pp. 273–8.

[7] See annual Federal budgets for the Employment and Training Administration, 1980 to current year.

[8] Based upon estimates provided by former Occupational Analysis staff.

[9] *Statistical Abstract of the United States*, U.S. Department of Commerce, Bureau of the Census, 1992, p. 422.

[10] Kutscher, Ronald E., "Outlook: 1990–2005, New BLS Projections: Findings and Implications," *Monthly Labor Review* (November 1991), U.S. Department of Labor, Bureau of Labor Statistics.

[11] *Statistical Abstract of the United States*, p. 47.

[12] Ibid, p. 10.

[13] Ibid.

[14] Immigration Act of 1990.

Performing a National Job Analysis Study

Robert Korte, Beverly Nash, and Jodi Smith
American College Testing Program

Executive Summary

What skills do employers look for in workers? Seventy-five percent of America's workers will not go to college or will not complete a bachelor's program. How do we make sure they have the skills they, and the nation, need to successfully compete in the global economy? How do we make sure that businesses striving to become high-performance workplaces have the skill resources available to do so? To answer these needs, the U.S. Departments of Labor and Education and the Office of Personnel Management formed a partnership to develop assessment measures of workforce competencies and skills as they were defined by the Secretary's Commission on Achieving Necessary Skills (SCANS).

The purpose of the assessment measures is to provide data about the skills of America's current workforce and about the skills individual workers need for our nation to aggressively compete in the global economy. However, because of the great consequences to individuals, and to the nation as a whole, it is essential to know and understand the specific competencies and skills needed before the assessment tools are created. Therefore, a National Job Analysis Study has been designed to empirically identify those job behaviors, or competencies and skills, that are common across occupations. It is only after this identification that valid and authentic measures can be created to help guide the education and training of America's workforce for high-performance workplaces.

With an evolving workplace, America's workers must have the ability to move from one specific job with its unique demands to a totally different job with its demands. Critical for this new workforce are the "cross-occupational" skills (that is, those that are common across occupations). These are the competencies and skills the National Job Analysis Study must identify.

This study began with the assumption that there are common behaviors across jobs and occupations that are worth learning and that are essential to the new workforce. While the study focused on looking across occupations, it soon became apparent that with slight modification, it could also support a larger vision. Without sacrificing its original goal, the National Job Analysis Study can provide pivotal information for setting industry skill standards, for describing individual occupations, for developing better ways of classifying occupations, and for developing cross-occupational skills and behaviors matrices. It can also provide focus to school-to-work programs and to job-to-job programs.

This new vision means that through a common database of skills and other job attributes, skill standards can be set across occupations, occupations can be more realistically classified, and displaced workers can better find jobs that truly match their existing and developing skills. Consequently, education and training programs can be finely tuned to meet today's, and tomorrow's, work environments.

National Job Analysis Study

Specifically, the National Job Analysis Study is designed to empirically identify workplace behaviors common across numerous occupations and linked to employee success in high-performance organizations. The study builds on the work of SCANS by seeking to empirically identify a comprehensive taxonomy of behaviors necessary for worker success. Three additional outcomes of the study are linked to establishing the behaviors as the basis for assessment and instruction:

- Construct a blueprint to guide development of content-valid workplace assessments. The blueprint will guide future assessment development activities by defining the contents of the assessments in terms of what is to be measured.
- Establish performance levels for the behaviors based on the relationship between the need for the behaviors and time on the job (e.g., at entry, after 6 months, after 1 year). These levels are necessary for the development of assessment measures and can also be used to sequence job training programs and educational curricula.
- Develop exploratory models of the relationships among all the behaviors in the taxonomy. These models can be used to identify possible learning prerequisites for the workplace competencies, helping teachers and trainers construct logical and efficient curricula.

The National Job Analysis Study employs a survey methodology to gather information from job incumbents across a representative sample of occupations. A panel of experts and other outside consultants will assist ACT staff in constructing the surveys, interpreting the resulting

data, and assigning the behaviors to taxonomy dimensions. The base study will be conducted in two phases.

Phase 1

The purpose of this phase is to identify an initial set of core behaviors that are common across occupations. ACT staff will begin the process by pulling task statements from databases that contain occupational information. Several criteria will be used to pull the task statements and determine their degree of commonality. The statements will then be translated into a common language and level of specificity, again according to set criteria. The translated behaviors and illustrative behaviors developed for the SCANS competencies and foundation skills will be compiled into survey 1. In accordance with sampling criteria determined by experts in ACT's Research Division, the survey will be distributed to 5,424 job incumbents in 2,712 organizations across the country. Approximately 150 occupations will be sampled. Job incumbents will be asked to rate each behavior in terms of how frequently it is performed and how important it is to successful performance on the job. Space will be provided for incumbents to describe and rate essential tasks not listed in the survey. A three-part mailing plan and follow-up phone calls will be used to ensure the highest possible rate of return. During data analysis of the survey results, an overall rating of criticality will be computed for each behavior, and a cut score will be determined to identify the behaviors that are most common and important across the occupations sampled.

Phase 2

The purpose of phase 2 is to verify the common behaviors identified from the first survey, link the behaviors to high-performance organizations, and establish the relationship between the behaviors and job tenure. Two surveys will be used to gather this information. Survey 2 will include the common behaviors identified from the first survey, the frequency and importance rating scales used in the first survey, and an additional rating scale in which job incumbents will indicate when the behavior is needed on the job. An environmental survey also will be sent to managers in the organizations sampled to determine to what extent the organizations meet criteria for "high performance." Data analysis of the results from both surveys will yield information about the relationship of the behaviors to high-performance workplaces and the levels at which the behaviors are necessary (for example, entry, after 6 months). It will also generate preliminary data on the relationships among the behaviors. A cluster analysis will be used to sort the common behaviors into similar groups. Ten content experts will then participate in a structured process to assign the job behaviors to taxonomic dimensions. This taxonomy will form the basis for constructing the assessment blueprint.

Comprehensive perspective

The base National Job Analysis Study is currently designed to identify cross-occupational behaviors. This "generic" focus illustrates the dynamic nature of today's jobs and reflects how critical it is for workers to have generalizable skills they can apply as changes occur within and across organizations and occupations. Consequently, the study is not designed to provide information about specific occupations or occupationally-related factors other than behaviors.

To meet a broader set of goals, the study can be expanded to include larger occupation-specific samples and additional work characteristics such as those found in the Occupational Analysis content model. Such additional information could form the basis for the development of occupational skill standards. Expansion would enhance the goals of this study and would also provide an efficient method of meeting the goals of other workforce initiatives. Specifically, such an expansion could provide:

- Skill standards that can be readily compared from occupation to occupation.
- Profiles of generalized work behaviors, tasks, knowledges, etc., for specific occupations.
- A common lexicon for describing behaviors, tasks, skills, etc., across occupations.
- Empirical information for classifying occupations and testing various classification models.

With these products, three government initiatives (that is, the Industrial Skill Standards Project, U.S. Employment Service's Occupational Analysis program, and the efforts to develop a new occupational classification system) can be better and more efficiently advanced. Modifying the job analysis study in a way that meets the needs of all three initiatives will result in significant cost savings and will ensure their integration. With this integration, it will be possible to describe occupations in identical terms for classification, skill standards, and descriptive purposes. All three initiatives will then be a part of a single system that will readily facilitate the vision of a national workforce prepared to successfully compete in today's and tomorrow's world economy.

Purpose of this paper

This paper has been prepared for the International Occupational Classification Conference to:

1) Illustrate the uses of occupational classification information in a national job analysis study, and
2) Propose a method of expanding the national study to provide a comprehensive database with which to develop and test models for classifying occupations. This paper is an excerpt of a larger, more technical presentation. It provides an overview of a National Job Analysis Study and of a more com-

prehensive approach built on the study. As a part of this discussion, it highlights how the study and its expansion relate to current and future occupational classification systems.

The base National Job Analysis Study is described in chapter 1, including the use of two current classification systems—the *Dictionary of Occupational Titles* and Occupational Employment Statistics—to define cross-occupational behaviors and to identify a representative sample of occupations across the nation. A conceptual model of the more comprehensive approach is presented in chapter 2, including the use of an expanded database to test, among other things, various new models for classifying occupations.

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Voluntary Skill Standards and Occupational Classification

James D. Van Erden
Employment and Training Administration

I'm glad Bob talked about the need to have industry skill standards, since that's what I'm going to talk about. I'm not going to give you a technical discussion on some of the issues that you've been exploring for the last couple of days. What I'd like to do is really talk about the process and the issues around classification of occupations from a little different perspective; that is as an ultimate end-user.

The Department of Labor has been very much involved in the setting of industry skill standards for the last 2 or 3 years. I want to talk a little bit about the demand for industry skill standards and why we see this as a very important component of where we're going. As you may be aware, there are a number of initiatives underway today dealing with increasing the level of skills, maintaining high wage jobs in this country and becoming competitive in an international economy. We have and will introduce shortly legislation on school-to-work, legislation on dislocated workers, legislation on one-stop shopping. These initiatives are designed to improve the way that we educate and train our work force and the way that we deal with the issues around our work force.

Let me go into a little bit of detail about each one of these and explain why industry skill standards are important.

On the issue of school-to-work, this country does not have a system that helps youth transition from the school system into the world of work. Unless an individual goes onto a college program, unless you have 4 or 5 years of time after you graduate from high school to age in the college or university environment to prepare you for work, no oppportunity exists to prepare you. If you look at our European friends, many of whom are here, and you look at their European systems, the dual system in Germany and Denmark and in other countries, you find there's a very different system to help kids transition.

When you review the process and say, "What really is important here is relating the skills of the work place, the demands of the work place, to what's being taught in the education system." However, we are faced with two sets of skill requirements. One is the basic skills you need to graduate; these are the academic skills learned in high school. The other is the skills to work in today's economy. The education goals project that the President has undertaken, and President Bush and the governors several years ago met on, basically is dealing with the kinds of competencies that people need to graduate from high school. But it's more than just graduating with competencies in arithmetic and reading and science. The real issue is how these relate to what is needed in the work place. When you get into relating the skills that are demanded in the work place with the skills that are demanded in the education system, you really have to start to focus on what is going on in the world of work, what are the skills that are needed, what are the levels that kids need to reach? So, as you talk about a school-to-work system, you have to begin to focus on not only the education component, but the work component and what goes on in the work place and relate school learning to workplace learning. This is the focus of the school-to-work initiative.

The initiative that we have underway to demonstrate this process is really reaching a critical point right now because when you talk about training kids beyond what is needed in the high school system to graduate, the questions are, what are the other skills, and what are the occupations that these people will be trained for? There's very little work, other than some work being done through the Carl Perkins Act in vocational education, that really begins to relate the skills in the work place with the skills in the educational system.

As you develop a much more broadly based, widespread school-to-work system, the issues of the skills for the occupations that these individuals are going to need and meet are very important. So, industry skill standards define the outcomes that are needed to move from the school system to the work system.

As many of you know, the issues facing dislocated workers in this country are being driven by many different factors: Defense downsizing, restructuring of our corporations, environmental issues, and global competition of trade markets. For those of you from Washington and Oregon, the spotted owls is an important issue. These factors, along with the traditional issue of restructuring and moving of workers from one particular industry to another are driving another look at how we deal with the worker transition issue; how we move from jobs we hold today to jobs that are available in the work place tomorrow. When you look at that, you realize that the jobs emerging are no longer the jobs that are defined by the 12,000 different occupations in the DOT. The jobs of tomorrow by themselves are changing very dramatically.

People who are dislocated from IBM today in terms of COBOL or mainframe programming skills are probably not in demand anywhere else in the country. The idea of being a computer systems analyst or a computer programmer in the world of mainframes and the world of PC's is very different. Many of those dislocated folks don't have the skills they need to transition into the new work place of PC's. They need to be retrained. They need to be reengineered to be successful.

Well, if we're going to spend millions of dollars in Federal, State, and private money to reengineer these folks, the question becomes, reengineered to what, to what kinds of skills? We need to have a system for industry skill standards that says these are the skills that you need to be successful in the future. There's no system in place, no structure, no set of skill standards, that allows workers to make that determination in any rational way. So, in terms of how we spend Federal dollars to reeducate folks, the idea of having a set of skill standards that we can train to, that we can assess people to, that we can use to determine whether the providers that we're paying to do this training are doing an adequate job, is very critical to a dislocated worker program.

The idea that Alan and others earlier spoke of—about having a customer-oriented system—is also very important. One of the things that we've been looking at closely is what kinds of information are provided to kids in the schools. Dave Steven's paper is very good in terms of setting up some of the problems. In order for these individuals to make rational choices, to make the kinds of choices they need, it's very important to have this information available. In order to do that, again you need to have from the industry a set of standards, a set of skills, that people need to be successful. In order to have this transition take place, the system has to be readily available, customer driven, and meet the needs of the work place.

We're trying to create high-wage, high-skill jobs. We're trying to maintain those jobs in this country. In order to do that, we really have to begin to identify what the emerging jobs are, what these skills are and then make that information on jobs and skills available to the general public.

We talked about high-performance work organizations, and I think that's a very big term. As Bob said, it's very difficult to define. I remember Ira Magaziner talking a couple of years ago, as a member of the Commission on Skills of the American Work Force, when a couple of folks asked him after a presentation, "What is a high-performance work organization?" His comment was, "You'll know it when you see it." It's very hard to define. But what it means is you don't have an organization with 55 occupations. You don't have an organization that is hierarchical. It means that you are empowering workers, you're driving the decision making down to the front line and in the process of doing that you're requiring that they have the kinds of skills these workers need at the front line to do a new job very different from the past.

An example is the Corning fiber optics plant in Blacksburg, Virginia. The plant has about 1,300 employees and they have two job classifications, two titles in that whole organization. I think there are about two people in one and the rest are in the other. The point is, when you're talking about a high-performance work organization, all of these various occupations, 10 to 12,000, get condensed down into a generalized description of the skills that are needed to perform many new functions.

When we were looking at this, beginning to look more and more into these issues, we were also approached by a number of mostly multinational firms. A lot of folks from Germany, companies who had been involved in the European skill standard setting, involved in the dual system, had come into this country and said, "We really don't have similar kinds of systems. We need to begin to move a process along so that we can have standards that are developed by the industry, that are available to the employers and employees, and that really inform folks about what's needed. Can you do something about that to help us?"

So, about a year ago, the Departments of Labor and Education began a series of demonstration programs. These demonstration programs are designed to be industry driven, industry led, and I'm defining industry to be a group of folks that represents the entire industry. It's not business; it's not the employer side; it's not the union side; and it's not the educator's. It's all of those folks coming together. The projects that we have underway are designed to explore how industry will come together and begin to define the skills that are needed in the work place.

We awarded six grants last year to major industry associations. Those six associations cover about 25 million workers. Somewhere, between 20 and 25 percent of the work force is represented by those industry associations. The Department of Education has awarded a similar number of grants.

In manufacturing and electronics through the American Electronics Association, in the hospitality industry through a consortium of 16 different associations that represent the majority of that industry, in the retail industry through the retail trade association, in the electrical industry through the Electrical Workers Union and other representatives of that industry, and in the International Launderers, work is now underway on developing industry skill standards.

I wanted to just relate a couple of important things to you that are coming out of the process. The American Electronics Association is perhaps the furthest along in their thinking. They're going into this project not looking at the particular occupations that they have, but in fact are looking at grouping these occupations into basically

four clusters. A manufacturing specialist is the first one that they're looking at, and this includes things like production associates, operators, production technicians, assemblers, et cetera. It takes really all the production facilities, all the production occupations in a plant, and puts them under one broad category. Now, that's not a new occupation, but it's back to what Bob was talking about when he said, "What are the skills, what are the kind of things that these folks need to be able to do in order to provide their employers with the services they need?"

So, we're finding that in this particular case, in AEA, they believe they can cover most of their non-baccalaureate work force with three general descriptions: Manufacturing specialist, pre-post sales analysis, and administrative information services support.

What we're finding then is that the idea of the traditional occupation is going away very quickly. The idea is what are the skills that workers need to respond to the demands of the work place. So, the overlap of the high performance work place with the idea of skills that are required is really what we're seeing in these dialogues.

In terms of the hospitality industry, they began their discussion by saying, "Which 500 occupations should we center on?" What you're finding as this dialogue goes along is exactly what Bob was showing on his charts. When you begin to define an occupation, what you're really concerned about is the skills that are required to actually perform that job. As you start looking at the definitions that we have in occupations, you find that these skills underlie all of them. So, you begin to throw away the idea of occupations and begin to ask, "What are the basic skills that we need?" They're not down to a small number yet, but they're clearly moving from the traditional, hierarchical occupational kind of analysis of a firm, into what the firm will evolve into, the high-performance work kind of idea.

One of the gentlemen on the AEA Advisory Board, Dave Barrun, who is from Apple Computer, points out very well that what you really want to do as you set these standards and you begin this discussion is to develop the skill standards for the jobs 5 years from now, not the jobs that you have today. So, the idea of looking at the skills and then moving that process forward into what the jobs will become is really paramount to this project.

There are some other issues that I think are important that are coming out of this process and let me just list a few of them briefly for you.

As we've looked at the development of national voluntary skill standards, we found difficulties using SIC codes for pilot projects. Different employers use different job titles to identify occupations with the same functional responsibilities, and thus we need a classification system which allows aggregation and disaggregation around the skills the stakeholders for voluntary skill standards partnerships define.

As we've said, the real problem here is that work is changing. The organization of work is changing, the demands of employers for workers are changing. The idea today is not, do you fit into a traditional occupation, but what skills do you bring to the work place. Those skills are changing rapidly. We know the average life of technology for an engineer today is 3 or 4 years. In several cases we've had people come to us, for example in the printing industry, and tell us that they can't even name the new jobs because they're changing so fast. They don't even bother to define the jobs because the technology is changing so rapidly that it just makes no sense.

This is the new world that we're talking about. Now, you say that's probably a manufacturing problem. As we know, the restructuring that has been taking place primarily in this country has been in the manufacturing industry. But if you really stop and think about it, the idea of restructuring, reengineering companies, reengineering organizations, is really now moving into the area of the service industry and moving into government. In fact, Secretary Reich assembled several hundred people from the Department of Labor for a 2-day retreat designed to reinvent DOL. A couple of months ago, Tom Peters at the invitation of the Secretary, addressed all the mid- and senior-level managers in the Department. There were about 1,200 of us in the room and he went through the whole issue of reorganization, reinventing DOL. I would tell you that he didn't say this. Let me make this very clear, he did not say this. But at the end of his discussion, I expected him to turn to the Secretary and say, "Mr. Secretary, I know you're very serious about this process and in order to test how serious you are, I want to reconvene this group in a year and I expect the room to be half full." The idea is that when you talk about restructuring you really are talking about changing the structure, the management structure, the way people work, empowering people at the front line, making them responsible for what they do, giving them the skills they need to do it, and flattening the layers of management. That's high-performance work. What does that mean for occupational classification? What is a carpenter today? What is a secretary?

If you think back to what your secretaries do today and compare this to what they did years back, I know your thoughts will be, "Thank God for word processors." But if you think back a little while, those of you who wrote papers years ago, you remember the process for writing papers: You'd write out in long hand this 30-page paper; you'd have your secretary type it; and then you'd remember on page 6 you'd left out a paragraph. You'd go out and you'd say, "Oh, please, could you white this out, could you then redo the whole thing so I can have my final paper done and ready for presen-

tation?" Today you walk out and your secretary is in the middle of Harvard graphics doing graphics for you to put into your document. Your word processor is up, the LAN is up, everyone knows how to operate all these systems and so it's a very different environment in which secretaries, professionals, technicians, and managers are performing similiar tasks.

The technology is very much different today. Thus the work that people perform is very much different. To go back into the DOT and say, "In 1977 or in 1986 this is what a secretary did," basically doesn't relate to what, in fact, is going on today.

One other example, while I'm giving examples, that I think really shows this issue. There's a plant in Columbus, Indiana, Cummings Diesel. Has anybody ever visited their main engine plant there? You have, Dave. Okay. Now, you can tell me whether I'm right or wrong on this. But this plant is really interesting because in probably 1 million square feet of the plant you can find all three levels of production that we've had in this country in the last 60 years. Let me just describe it for you.

You go into the back of this plant and there's this huge bay. It looks like the old iron works. Everything is riveted and the building is all—something you expect to see in the 1920's. This is where the rough engine blocks come into the plant. These are diesel engines they're producing. These rough blocks come into this really creaky, crankety old production line and there are literally guys with the oil cans that are oiling the chains and oiling the machines that are doing the final boring on this plant. It just gives you this feeling like you're back in the '20's or the '30's watching this process go on. The machines move from one spot to the next and the people are basically charged with keeping those machines running through minor adjustments and oiling and so on.

Then you go into the next part of the plant where they actually put the engines together. The point of the plant is pretty much as I visualize a '50's, '60's, maybe early '70's automotive production line to be. Here you have a fairly flexible assembly line, engines moving down the line, but people are able to maybe do engine B and engine A, one right after the other; large air hoses in the air guns and things like that. But they're basically putting parts together and it's still fairly traditional. There's not a lot of flexibility, but a lot more than you had in the first place.

Then you go into the third part of the plant and this is where they make all of the components for the engine, all of the parts that fit on. You walk into this great big room and you don't see anybody. Up in one corner there's a little booth where the computer operator sits. Over in another corner there's another little booth where another computer operator sits and that's all you see in the entire plant, in that section. That's one-third of the plant.

So, what are the occupations of these folks? How does this fit into where the environment is going? I think this is a basic issue as we talk about occupational classification, we talk about skill standards, how these things merge, what does it mean, what does it mean for a work place that looks like a work place with two people up in the corner? It's a very different environment.

Well, those are issues, I think, that we have to consider as we think about redefining an occupational classification system.

Let me finally just bring up one other issue that's going to have a big impact on this. Today on the House Education Labor Committee there's a mark-up on H.R. 1804. H.R. 1804 is the Education Reform Bill. The real interesting part from our perspective is Title IV of that bill, which proposes to set up a national skill standards board. This board will be established as a freestanding board. It will be made up of representatives of business, labor, education, and other groups. The purpose of this board is to promote the development and endorsement of a national system of industry skill standards. By industry I have to define it as both industry in the vertical sense and industry in the horizontal sense, realizing that as you look at occupations within a particular industry, as we've seen before, those skills clearly cross industry lines.

So, this board, whose purpose is to foster and promote a skill standards system, will be established if this bill is passed. We would then really anticipate seeing a very major effort to develop industry standards. This will be, as I said, a freestanding board, so it won't be a Department of Labor, or Department of Education board. It won't be a government board.

What we found in our public dialogue last year on this issue when we conducted hearings around the country was that there was a role for government, but the role for government was not to set standards. The role for government was not to implement those standards. If you're going to have industry skill standards, they have to be driven by industry, owned by industry, operated by industry. Otherwise they won't work.

We have cases in this country today where there are industry standards. They're limited, but there are cases where they have worked. But I think the consensus from business' point of view, labor's point of view, and certainly from the education providers and from our point of view, is that industry standards need to be developed, need to be in place, need to be there for all of our programs and all of the other education and training programs that are in place today. If we don't turn this process into an outcomes-based process, looking at what skills are needed, when I say process I'm talking about the education process, then we're not going to succeed. This particular component of this process is very critical.

It's sort of the glue that holds together the training and the education systems that I've talked about. It will provide employers with a way to assess folks they want to hire, to see if they have the skills they need. It provides employees with the ability, and perspective employees, to determine what their skills are and how they need to upgrade those skills in order to be successful in the work place.

So, this issue is not going to go away. The issue of skill standards, I think, is going to, if nothing else, get more intense over the next few years. It has a lot of implications for what you do. What you do has a lot of implications for this. My sense is that they're still some degree apart and that they need to begin to come together.

With that I'll open up for any questions. Thank you.

Discussion

JAMES WOODS: One of the things that I have found quite encouraging is the recognition throughout all of the papers of the need to look at user needs. But then, the uses are very paramount to the decisions that are going to be made in terms of a new classification system. Ultimately what needs are we trying to meet?

In fact, we've been discussing users so often, it's somewhat tempting to begin by saying, "at risk of belaboring the point, we're going to look at user needs." I thought about that and then I thought no, that's a misstatement because you can't belabor the point. If we do not keep in mind the multiplicity of uses out there, I would suggest that we are destined to basically put together a classification system that isn't going to serve anyone's needs. I believe Mr. Triplett in his comments posed the interesting notion that perhaps the Standard Occupational Classification system, designed in 1977 and revised in 1980, was not meeting certain needs out there.

To look at that just one step further, let me go back to the statement which we discussed yesterday right out of the 1980 version of the Standard Occupational Classification system, which states, "This system is designed for use in statistical analysis and presentation of data on occupations. It was not developed for any particular programmatic use." I think it is a real question as to whether the SOC is meeting all of the applications or uses for which it's been designed. Secondly, in looking at that issue, if it is not meeting all of the needs, why not? Is it totally because of issues and possible problems with the SOC or perhaps is it in part, and let me play off the comment from Odessa Dubinsky yesterday, due to lethargy on the part of agencies that collect, categorize and classify occupational information for their own applications and self-interest, and agencies that, at times, do not look at a broader range of user interests.

I think the challenge in designing any new classification system is how are we going to try and meet those needs. No one said it's easy! I think the points that Tom Scopp raised were also well taken, that we really have to blend different interests, different needs in looking at this. As difficult as that challenge is, I think it's the one that we face.

Let me talk to you for a moment from the standpoint of the organization for which I work, the National Occupational Information Coordinating Committee, that basically tries to deal with and bring together occupational information across many different programs and to bring it together in a way that makes it more useful to a variety of users, including 7 to 10 million people using career information. They quite frankly don't care what classification system is being used or what all of those statistical problems are that one faces in doing this. They want information. For those of you that perhaps have not had a chance to read Dave Stevens' paper yet, take a look just at the first couple of pages, which I think really lay it out on the line with a little scenario of a young lady who wants information and how difficult it is to obtain it, because of differences across classification systems. Our challenge is to address that need.

Our organization, and Pam Frugoli, who is a member of the staff here today, has been dealing with the issue of crosswalking across these different systems for many years and we're faced with that because of the divergent systems that are out there. Mark Loewenstein made a comment which I think is very important. It may not have been the intent of his comment, but let me just paraphrase it, ". . . that the Census and the OES roughly correspond to the Standard Occupational Classification system," and he's absolutely right. They roughly correspond to the Standard Occupational Classification system. The problem is when one starts to look at that roughness and bring the information together, you have to make many decisions and you have to compromise. In doing that, we have found that we have been unable to use the Standard Occupational Classification system, I think, in the way that it was intended. That definition, I noted earlier, ". . . not intended for any specific programmatic purpose . . ." I would suggest to you, doesn't mean that it's not intended for programmatic purposes. In point of fact, the reality is that if it doesn't serve programmatic needs, guess what? It will not be used! Try to analyze information across classification schemes. We've been doing that for the last 15 years. Just try to put information together in a standard occupational classification scheme when the OES roughly corresponds to it, when the Census roughly corresponds to it. It's quite challenging.

So, my point is that I think what we face here is designing a system, regardless of what title we place on it, that on one hand can look at the multiple needs that are out there, but recognize you can't do a perfect job of meeting all of those. We need a classification system that, if not a totally consolidated system, which I think would be the most ideal model, certainly is one that allows and provides a real framework for integrating specific programmatic needs into a system in which we can then truly group that information and make it more useful.

THOMAS PLEWES: Forgive me if I involve all of you in a dialogue with the folks that I consider to be our customers as a statistician, but this is a golden opportunity. Let me first engage Al Moss, if I could.

I liked what you said, but when I look at you as a customer, I see something very different. In fact, I heard Bill Bailey say that the reason that we go through such tortuous descriptions of occupations, that we worry about levels, that we worry about crossing the T's and

dotting the I's, that we have 50 pages of description that Seymour Wolfbein talked about the other day, is because you as our customer, you as a person who has responsibility for administering the Service Contract Act and other kinds of things, need that kind of information, that kind of detail to do your job.

So, I think there's a conflict here between what you would like to do to generalize occupational descriptions and what you're telling us as our customer.

ALAN MOSS: I guess I would disagree in terms of there being a conflict. I think what we have to do is broaden our horizons a little bit and put ourselves in a situation where we can serve more than one interest, where if someone needs just a general job description, you can provide it. If someone like myself who has to have very detailed descriptions nailed down so we can defend what we issue, then you provide that level of detail. I just don't see why we can't provide more than one level.

ELEANOR DIETRICH: I work with a community of users that are individuals making decisions about what kind of career they want to go into or what kind of job they might find. In trying to help them get this information, I have to put lots of pieces together.

I think two issues come out of that that I'd just like to add. One is delivery. I think Dave was talking about going to the bookshelf and picking off the books and, Alan, you had your table where you had all your materials there. What happens now is we're delivering it through computers and the users have no idea whether it's complete or whether it's accurate. Our ability to deliver that information is far exceeding the quality of the information that we have to provide to people. So, if we assume that people are going to make better decisions with better information, I think how we deliver that is going to be real critical. I think we're going to get it from lots of places.

I have a list of 17 major resources I've put together to try to provide one occupational description and I think some of that is just a reality. So, I think that's really important to look at.

The other thing I'd like to add is about the classification systems. I'd like to see an education taxonomy included in that because if we don't look at how we prepare people and how we describe our programs for preparation, we're not going to be able to connect that to what we do in our work and how we make those decisions. So, I think involving that community in the decisions that we make about classification would be extremely important.

SAL CORRALLO: The last point is that this is a new world for me. I work primarily in post secondary education and I'm concerned with National Goal 5–5, if you know what that is. It's the communication and higher order thinking skills of college graduates related to work and education. It's hopefully one of the things on the docket. Our concern is something very basic.

I was talking with Bob earlier about the notion of skills. If you ask every person in this room what do you mean by skills, the feeling I get is you'll get different answers because it could be competencies, it could include everything back to reading and writing. So, I think one of the things that's very important is the bridge between work place competencies or skills, and I call them competencies because they come from knowledge and skills that the industrial psychologists spend time with. It's how we come back. It's very important that that bridge be considered so that when, for example, the SCANS (Secretary's Commission on Achieving Necessary Skills) people came out with the six competencies and encouraged people to implement them into the schools, it'll make it easier for schools to do that. They need to go back to the foundation skills in the SCANS competencies and relate those because that's what happens in the classroom, you build up. So, one of the hopes as you go along is that somehow that bridge be developed back to the very basics so that the schools themselves can take that and develop it into the curriculum. You just don't start at the job competencies or skills, as you call them.

JAMES WOODS: On that last issue, we have some folks here, Eleanor Dietrich, Paul Hadlock, or Pam Frugoli who can tell you just how much fun it is when one sits down and works with trying to bring together educational information through the Classification of Instructional Programs with occupations because there are separate classification systems, and, many of us would argue, and need to be because they're doing different things. But one needs to bring them together for a number of purposes and again the consistent system helps us.

DIANE WAGENER: I was thinking about our Department of Health and Human Services and came up with at least three or four different uses we have for occupational data. One in terms of manpower needs and manpower management. We also use occupational data in characterizing risks to health either in terms of injuries or toxic exposures and the like. That's a whole other dimension that hasn't been considered very much. We use occupation in terms of defining people socially, socioeconomic status, and education. This is an obvious way that we tend to put people in terms of their social context and how they might have access to health care. Finally we use it in terms of defining people in their employer-based benefits that impact on health care either in terms of provision of insurance or in terms of health promotion activities.

So, this is a wide range of uses and needs in defining occupations. I'm just building upon what's been said

earlier and that is that there is not going to be one single grouping that is going to satisfy all of our different needs. It's going to be different groupings and Joe Blow or Blau may do it one way and Annie Smith may do it a different way. So, what we've really got to do is define all these uses, define the data items that are going to be needed and how to get them.

Now, this comes to my concern. I'm from the National Center for Health Statistics and we get information on occupation through personal interviews. As has been mentioned many times, personal interviews and establishment surveys are two very different ways of getting the data. In interviewing somebody, if I asked them what their skills were, I would have a very difficult time trying to define that, whereas I can ask them about tasks and they're much better at defining that. An establishment survey would give you very different kinds of information.

So, I'm struck with the fact that for me, I would think that the process we need to go through is first in identifying the users, determine the data item needs. Second, to identify the smallest discriminatory groupings you can get from either of these two different sources of data. Sources of data have got to be an important factor here. Then three, come up with some grouping schemes that accommodate these different sources of data so that you can combine them. I've heard many complaints about, "Well, I can't do this with that and that with this," in terms of different sources of data. Well, you're stuck with the different sources of data. You're going to have to define the groupings to accommodate this. We have bridging needs from very different sources for these particular data.

JAMES WOODS: Let me just add a final point on that. Looking at Alan's list, you see a number of different criteria that he laid out.

It seems to me also that one does not necessarily have to look at the particular classification system and the different ways in which we may need to group information.

For us, quite frankly, the de facto classification system in occupations has been the Occupational Employment Statistics program. Now, it doesn't have everything in there, but the OES classification scheme, for very pragmatic purposes from our standpoint, became very useful because of the fact that projections were developed by occupations. We needed that for our user communities and also the power of that system, by relating occupations to industries and a chance to integrate and look at an occupational staffing pattern within an industry and what that might mean, and at the same time, look across industries. It becomes a very powerful tool.

So, a classification system by itself may not have all of that, but if information is collected in that context or another program, in this case through BLS and the State Employment Security Agencies, then the information can be used in that manner.

I guess my closing point is we've discussed skills information. Mr. Triplett alluded to the SIC revision in his presentation and we're talking about occupations. It seems to me that we're at a point in time right now that we have an opportunity that perhaps we've never had before, and that we need to take care not to look at these in isolation of each other. I think part of that came in Jim's comment too, that there are interrelationships here that give us a chance if the SIC is being revised in 1997. If we're looking at revising an occupational classification system and we're looking at voluntary standards and a board being established to look at this, then we have a real opportunity.

Module 4. Possibilities for a Unifying Classification System

Introduction

The need for and possibility of developing a unifying occupational classification structure in the United States are the core papers of this section. Neal Rosenthal describes current user frustrations in trying to piece together various elements of occupational information that must be derived from different incompatible classification structures. Donna Dye provides an overview of the work of the Advisory Panel of the *Dictionary of Occupational Titles* and the Panel's recommendations concerning occupational classification. David Stevens makes the case for unifying the classification structure of the *Dictionary of Occupational Titles* and the new SOC in order to be able to compare occupational information about the qualifications, opportunity, and demand for occupations. Richard Dempsey analyzes the current SOC and makes recommendations for how it should be changed to facilitate data collection from both establishments and households.

Analytical Problems Stemming from Surveys Having Different Occupational Classifications

Neal H. Rosenthal
Bureau of Labor Statistics

A wide variety of statistics are collected about occupations in the United States. Surveys are conducted to compile data about occupations by several Federal Government agencies, State governments, colleges and universities, and professional, trade, and industrial associations. For a variety of reasons, however, much of the occupational data generated by these surveys are not comparable. This paper discusses the problems stemming from the lack of comparability that are faced in analyses which depend on occupational data from different sources. Although it focuses on analyses conducted in the Division of Occupational Outlook in the Bureau of Labor Statistics (BLS), it reflects the problems faced in any analytical effort that uses occupational data from many sources because comprehensive data are not available from one source.

The occupational outlook program

In the BLS occupational outlook program, occupational employment data are analyzed along with other labor market information to identify current and past trends in job market conditions for use in projecting future occupational employment trends and job prospects. Related information also is developed for use in career guidance and education planning, such as earnings, education and training needs, job duties and tasks, work injuries, and working conditions.[1] The Division's products are widely used, primarily by people making career decisions and planning their education, but also by technical audiences as input into other research and analysis efforts.

Data on employment for the occupational outlook program are derived through use of an industry-occupation matrix. The matrix uses occupational staffing patterns of industries collected in the Occupational Employment Statistics (OES) survey[2] and industry employment data from the Current Employment Statistics (CES) survey.[3] Because the OES survey only collects information on occupational staffing patterns of wage and salary employees from establishments, other sources of data are needed for employment of self-employed workers and for other types of analyses done in the occupational outlook program.

Employment of self-employed workers and demographic data, including age, sex, race, Hispanic origin, and educational attainment are derived from the Current Population Survey (CPS).[4] Earnings are derived from several sources, including the CPS, the Bureau's wage surveys conducted by the Office of Compensation and Working Conditions, and surveys conducted by professional associations. Data on job mobility and labor force separations used to develop estimates of job openings to replace workers who leave their job are derived from CPS statistics. Descriptive data on job duties are based on information from the Dictionary of Occupational Titles (DOT). The Bureau's Survey of Occupational Injuries and Illnesses provides information on work injuries. Research studies conducted by the BLS Office of Productivity and Technology, other government agencies, private research organizations, and colleges and universities are the sources of a wide variety of information about the effects of technology on occupational duties and employment.

Linking the data

The OES survey and the CPS, the sources of the majority of the data used in the occupational outlook program, both use the Standard Occupational Classification (SOC).[5] However, neither of these surveys uses the SOC in its entirety or in the exact format. The lack of comparability among the data in these two surveys resulting from seemingly inconsequential differences from the SOC and from each other, provides an excellent medium for studying the analytical problems stemming from occupational classification differences among surveys.

The BLS, which conducts the OES survey and the Bureau of the Census, which conducts the CPS under contract with the BLS, each has its own reasons for diverging from the SOC. Some reasons touch upon survey methods and the type of survey. (The CPS is a household survey in which data are collected through interviews with individuals. In contrast, the OES survey collects data by mail from establishments.) For example, the Bureau of the Census believes reliable data cannot be collected from individuals for some SOC occupations that are covered in the OES survey. Other differences between these surveys reflect differences in the decisions of the agencies about where a specific occupation should be placed in the occupational structure of the SOC. Both the Bureau of Labor Statistics and the Bureau of the Census describe the occupational classification system used as "SOC compatible."

All the decisions to differ from the SOC made by BLS and the Bureau of the Census seem to have merit. In one case, both agencies made the same decision—

to move airplane pilots from being grouped with transportation occupations (truck drivers, locomotive engineers, etc.) to a grouping called technicians, except health, engineering, and science. This SOC inconsistency does not affect the analysis of airplane pilots because the two major sources of data are the same. However, if airplane pilots were put in different places in the classification by each agency, the group totals for the categories in which they were included would not be comparable.

To illustrate differences in the classification between the SOC, CPS, and the OES survey, two occupational fields were chosen, carpet installing and tile setting occupations. In the SOC, CPS, and OES survey, these occupations are titled as follows:

SOC	CPS	OES
Tile setters, hard	Tile setters, hard and soft	Hard tile setters.
Carpet installers and soft tile setters	Carpet installers	Carpet installers.
		Floor layers, except carpet, wood, and hard tiles.

In reviewing the titles, there is no apparent problem in matching carpet installers in the CPS and OES survey, because they have the same title. But, like the SOC, hard tile setters in the OES survey excludes soft tile setters, whereas, unlike the SOC, soft tile setters are combined with hard tile setters in the CPS. When examining the details of the DOT to SOC relationship, however, the DOT and SOC definitions, and the job titles placed in each category in the CPS (the CPS has no formal occupational definitions), differences emerge that are not apparent by the occupational titles.

Most important, the examination shows that carpet installers are not identical in the CPS and OES. The CPS category, carpet installers, includes linoleum floor layers who are not included in the OES survey category carpet installers, but are in another OES survey occupation, floor layers, except carpet, wood, and hard tiles. As indicated by the OES survey title, soft tile setters (which means decorative steel, aluminum, or plastic tile according to the DOT[6]) are not included with hard tile setters. They are included along with linoleum layers in floor layers. Therefore, as expected, the OES occupation, hard tile setters, is not comparable to the CPS occupation, tile setters, hard and soft. Adding OES carpet installers together with OES floor layers, except carpet, wood, and hard tiles, however, would result in a comparable category to the SOC carpet installers. If you have followed this matching process, some of you may agree with the CPS classification and others with the OES survey or SOC classification. But all should agree with the following: Who needs this confusion? No one benefits.

Facing the analytical problems

The analytical problems caused by the lack of comparability in the occupational classification used to compile data for these occupations illustrate the problems faced in many other occupations. Based on the review of the comparability of the CPS and OES survey for carpet installing and tile setting occupations, a decision had to be made whether or not the CPS data on the number of self-employed and earnings, sex, race, and educational attainment for tile setters, hard and soft, are characteristic of the workers included in the OES matrix based employment for hard tile setters. Only one thing was known for sure, there is a comparability problem that results in an analytical problem.

When an analytical barrier is presented, analysts naturally look for a way to deal with it. As will be seen later in this paper, the OES survey data show there are approximately twice as many carpet installers as floor layers, except carpet, wood, and hard tiles. As a result, the CPS data on carpet installers were used as a proxy to provide CPS information about carpet installers in the OES survey-based matrix. If that decision were not made, there would be no CPS data on carpet installers to use in the occupational outlook program. For floor layers, except carpet, wood, and hard tiles the same problem was faced. CPS data for carpet installers would also have to be used to describe these workers. Another alternative is to collapse the employment data into a residual occupational category and forgo any analysis. The occupational outlook program used that method. Employment data for floor layers, except carpet, wood, and hard tiles were collapsed into the category, all other construction trades workers; these employment data were then eliminated from presentation in the occupational outlook publications. Another alternative, which was considered but not selected, was to combine OES survey occupations carpet installers and floor layers, except carpet, wood, and hard tiles and use CPS data that are comparable to this combined OES survey grouping. For hard tile setters in the OES survey, it was determined that CPS data for tile setters, hard and soft, reflected their characteristics, because there probably are very few soft tile setters.

The exercise I have just described leading to the decision about which occupations in surveys that compile occupational data theoretically match the OES survey is repeated for every occupation that is analyzed in the occupational outlook program. Of course, help is provided through a crosswalk that bridges the OES, SOC, CPS, and DOT. This crosswalk is based heavily on the DOT content (the lowest common occupational classification denominator) of the SOC and job titles categorized in each occupation in the CPS. Users of the crosswalk, however, must go through the agonizing detailed look at codes and titles to be assured that the data from two different surveys match for a specific occupation.

Therefore, a significant amount of valuable staff time is spent on looking at the details of the crosswalk. Of course, there also is a multitude of time spent, thankfully by others, in developing the crosswalks, maintaining them as surveys change, and distributing and interpreting them.

It is no wonder that thoughts of the analytical community often center on developing a classification system whereby all data collection programs would use an identical occupational classification.

Why do we have a problem with the SOC?

The first paragraph of the introduction to the *SOC Manual* states: "The Standard Occupational Classification provides a mechanism for cross-referencing and aggregating occupation-related data collected by social and economic statistical reporting programs. The system is designed to maximize the analytical utility of statistics on labor force, employment, income, and other occupational data collected for a variety of purposes by various agencies of the United States Government, State agencies, professional associations, labor unions and private research organizations." Why have BLS and Bureau of the Census (not to mention the Federal Government's Office of Personnel Management and others) chosen to differ from the SOC? Neither BLS or the Bureau of the Census have a major data collection program to compile industry statistics using a classification that differs from the Standard Industrial Classification (SIC).

Because of my intimate involvement with occupational statistics over the years, I believe there are several reasons why these agencies and others take a position that they could differ from the SOC in a major occupational survey. One reason stems from the general feeling that the SOC has some obvious problems. For example, using the example of tile setters, many analysts would say that combining soft tile setters with carpet installers instead of with hard tile setters is an error in the SOC. I am not being facetious when I say that the error probably was made because those who made the decision thought soft tile was linoleum. In addition, the principle of classification that occupations should be placed in homogeneous groups has raised many concerns about the classification as some SOC categories are apparently not in a logical place in the classification. For example, BLS and Bureau of the Census agreed on one of these, that the SOC placement of airplane pilots was incorrect.

Another problem lies in the fact that the agencies making the decisions to modify their survey classification from the SOC are primarily statistical agencies. Consequently, if a question of data reliability is in conflict with an occupational classification question, data reliability generally wins out. Perhaps for this reason, the OMB, which must approve survey questionnaires by Federal Government agencies, agreed to waive absolute comparability to the SOC in the surveys it reviews.

Will uniformity solve all problems?

This paper focuses on the need to develop an SOC that can be used by the BLS in its surveys of occupational employment and its surveys of wages, by the Bureau of the Census in categorizing workers by occupation in the Decennial Census and the CPS, by the Employment and Training Administration in developing a revised DOT, by State government agencies in compiling information on the occupation of job applicants at employment service offices, by OPM in classifying employees by occupation who work for the Federal Government, and by others collecting or presenting occupational data. From an objective analysis of the data, however, it is clear that this theoretical "classification uniformity" will not always achieve the desired results.

My earlier comments on tile setters and carpet installers showed that despite the lack of identical CPS–OES definitional comparability for tile setters and for carpet installers, there appears to be sufficient comparability to use CPS data as a proxy for perfectly comparable data. The CPS collects data on employment as well as on demographics of workers, earnings, etc. Therefore, it seems appropriate to compare the employment levels in the OES matrix with the CPS for comparable occupations. The employment levels may not be identical because of many technical or survey methods reasons. For example, the CPS counts each person once in his or her primary job, whereas the OES survey is based on payroll records and if an individual held more than one job they would be counted in each one. In addition, the CPS is a household survey in which an individual's response to questions about his or her job are coded by occupation. In the OES survey, employers report the occupational distribution of their employees on a questionnaire that includes descriptions of work along with an occupational title. Despite these technical differences, for most occupations the employment levels in occupations with comparable definitions in the two surveys should be reasonably close.

As shown in the following table, the employment data for tile setters and carpet installers seem to imply something other than comparability. The 1990 CPS employment of tile setters, hard and soft is more than double the number of hard tile setters in the 1990 OES survey-based industry-occupation matrix. Because the OES survey-based data indicate that there is a maximum of 12,000 soft tile setters (the entire estimate of employment for floor layers, except wood, carpet, or tile), questions can be raised about whether the earnings, sex distribution, etc. of the 68,000 individuals reported as tile setters in the CPS should be used to describe the 28,000 workers employed as tile setters reported in the industry-occupation matrix. It should be pointed out that the number of self-employed workers (11,000) in the matrix are based on CPS data and, therefore, the wage and salary worker comparison is 57,000 in the CPS to 17,000 in the matrix.

CPS occupation title	Employment 1990 (thousands)					
	CPS			OES matrix		
	All	Wage and salary	Self-employed	All	Wage and salary	Self-employed
Tile setters, hard and soft	68	57	11	28*	17	11
Carpet installers, plus floor layers, except wood, carpet, or tile	109	64	45	85*	40	45

* In the matrix, an estimated 12,000 floor layers, except wood, carpet, or tile, which includes soft tile setters, are included with the OES data on carpet installers because most are believed to be linoleum layers.

The relationship of 109,000 carpet installers in the CPS to the 85,000 in the matrix is much less disturbing, especially because there are 45,000 self-employed workers.

Clearly, definitional comparability does not necessarily mean perfect comparability. Yet, if the questions about definitional comparability could be eliminated in deciding whether to relate CPS and OES survey occupational data, analysts could focus their time on statistical tests and analytical procedures rather than on dealing with crosswalks.

Can it work?

I have a hope that some day all occupational information used in the analyses conducted in the occupational outlook program will be based on the same occupational classification. Hopefully, one day all data on occupational employment, demographic statistics, earnings, descriptions of job duties, tasks, and skill requirements, and all other types of information compiled about occupations will be comparable. Hopefully, the occupational codes in the CPS and the OES survey will be identical for occupations that are theoretically comparable. And, the DOT's aggregation or classification system, hopefully, will be identical to the CPS and OES survey, even though it will have much more occupational detail. Consequently, for the first time employment data will be available for occupational groups classified in the DOT.

This hope may be far fetched. But, there is no question in my mind that it is achievable. To work, however, agreements must be reached among the Federal agencies involved, and no individual agency can be allowed to take the position it can solve a technical problem by deviating from the Federal Government's occupational standard because of any problem. And, once again, it seems to work for the SIC, perhaps not perfectly, but reasonably well.

Summary

This paper shows the importance of using the same occupational classification in the variety of data collection programs that compile occupational data. Although it focuses on the problems of the analytical community, the benefits would be felt by all users of occupational information. The paper does not deal with some of the most important subjects to be faced in the SOC revision, such as the principles of classification and the structure of an occupational classification. However, I hope it has pointed out the need for those involved with the SOC revision to consider the importance of data uniformity. At the outset, the statistical community must decide if adhering to the revised SOC should take precedent when choices have to be made in data collection programs. If there is general agreement that uniformity is desired among data collection programs, then it can be done—if those who develop the SOC consult with and consider the analytical uses of occupational data. If data users as well as data producers contribute to the development of the revised SOC, agreements and compromises on classification issues and problems can be made. But, they will be adhered to only if conformity to the SOC is necessary.

Notes

[1] For more detail on the occupational outlook program see *BLS Handbook of Methods*, Bulletin 2414 (Bureau of Labor Statistics, September 1992, pp. 128–139).

[2] For a detailed description of the Occupational Employment Statistics Survey see *BLS Handbook of Methods*, Bulletin 2414 (Bureau of Labor Statistics, September 1992, pp. 29–31).

[3] For a detailed description of the Current Employment Statistics survey see *BLS Handbook of Methods*, Bulletin 2414 (Bureau of Labor Statistics, September 1992, pp. 14–28).

[4] For a description of the Current Population Survey see *BLS Handbook of Methods*, Bulletin 2414 (Bureau of Labor Statistics, September 1992, pp. 3–13).

[5] See the *Standard Occupational Classification Manual*, (U.S. Department of Commerce, Office of Federal Statistical Policy and Standards, 1980).

[6] See DOT code 861.381–034 Soft-tile setter, *Dictionary of Occupational Titles*, Volume II, Fourth Edition, (Employment and Training Administration, Revised 1991, p. 897).

Recommendations Concerning the Standard Occupational Classification and the Dictionary of Occupational Titles

Donna Dye
Employment Training Administration

The DOT review

During the past few years the U.S. Department of Labor (DOL) has been conducting a review of the *Dictionary of Occupational Titles* (DOT) with the purpose of ensuring that the DOT becomes an effective tool for meeting the workforce challenges of the 1990's and beyond. As the nation's single most comprehensive source of occupational information, the DOT is uniquely positioned to help the U.S. Department of Labor shape its response to the issues of workplace changes, occupational classification, and skills development. The intent of the review was to increase labor market efficiency and to assure that the DOT responds to the diverse needs of the occupational information user community. In supplying critical data to support the effective education, training, counseling, and employment of workers, the DOT can help improve the competitiveness of the American workforce and revitalize the workplace.

To complete the DOT Review, the Employment and Training Administration (ETA) convened the Advisory Panel for the Dictionary of Occupational Titles (APDOT), conducted a user survey and explored new methods for collecting, analyzing, organizing, publishing, and disseminating occupational information. Staff support for this initiative was supplied by the U.S. Employment Service (USES), Robert A. Schaerfl, Director; the Occupational Analysis Field Center staff (OAFC), grantees to the U.S. Employment Service; and Aguirre International, the consulting firm selected to manage the DOT Review process on-site at the Department of Labor. Marilyn B. Silver, Ph.D., was the Project Director for the DOT Review. Donna Dye, USES, was Project Officer and supplied technical direction.

What follows is the Executive Summary of the APDOT Final Report. It contains recommendations for a single occupational classification system for the nation. The U.S. Department of Labor is in the process of analyzing the recommendations and developing an appropriate response.

Executive Summary

The New DOT: A Database of Occupational Titles for the Twenty-First Century

Final Report of the Advisory Panel for the *Dictionary of Occupational Titles*

> "The only way America can compete and win in the twenty-first century is to have the best-educated, best-trained workforce in the world, linked together by transportation and communication networks second to none." [1]
>
> President Bill Clinton

• Amanda Strong, a dedicated teacher, has brought education and business together to address pressing community problems. She has won wide support for her success in translating the skills, knowledge and abilities employers say are needed for success on the job into meaningful learning objectives for her students. Because of the new DOT, Amanda was able to move beyond generalities about the need for "a work ethic" or "problem solving skills" to a level of detail that resulted in real understanding. Now Amanda has the tools and information to make a real difference in the future of her students!

• When he left the service, Luis Rivera, a veteran with a college degree and 20 years of experience as a defense analyst, encountered many problems trying to identify and match his transferable skills with those in the private sector. Now, employed in a "downsizing" industry, he is amazed that technology has made this task easier. With the new DOT, Luis is able to align his proficiencies with the workplace requirements of jobs in "growth" industries to secure a successful job match.

• Jackson Graham, a labor policy analyst developing retraining programs for dislocated workers, begins his efforts by estimating the skills gap between worker capacity and workplace requirements. The new DOT, a national database system that replaced cumbersome crosswalks

among national data sets on job content, demographics, wages and employment trends, makes his task easier and allows him to serve more people effectively.

• Leslie Tanner, a small business owner, is convinced that she needs to restructure her business into a high performance workplace if she is to stay competitive. Leslie wants to use a skill-based pay system to improve productivity. She plans to pay staff 10–20 percent more if they diversify their skills. Leslie is delighted to find the information she needs to help sales staff identify the skills involved in handling billing, production, delivery, scheduling, and technical support on a sales call, in the new DOT.

The experiences of these people and millions of others will result from the nation's creation of a concise, accurate, and up-to-date occupational information system. A database system that identifies and describes the skills, knowledge, and competencies needed to produce a high performance workplace will help millions of students, workers, and employers to make informed decisions. This new *Database of Occupational Titles* (DOT) will help eliminate costly mistakes in their education, training, counseling, and employment efforts. A renewed commitment to identify, define, describe, and classify occupations, in an accessible and flexible manner, is critical to the success of future plans for workforce investment.

As early as 1996, what is now the *Dictionary of Occupational Titles* (DOT), the Nation's single most comprehensive source of occupational information, can be transformed into a database system useful and accessible to millions. In work stations at home, in school, and on the job, the new DOT can provide the *infrastructure* or national framework needed to support the Administration's planned investment in people and their skills. It can become a vital tool for students, parents, and teachers inquiring about the world of work, for workers in transition and for employers restructuring occupations to accommodate employees with disabilities, responding to new competitive forces and designing training programs. In developing a new DOT, the U.S. Department of Labor can give an important boost to U.S. productivity and promote the effective education, training, counseling, and employment of the American workforce.

The workforce issue and the DOT

To succeed in the global economy of the twenty-first century, the United States must improve its productivity and competitiveness. While technology and capital investment play a role in productivity improvements, a growing consensus among national leaders suggests that the key to a more prosperous future for this country is a major investment in the skills of our people and the restructuring of our workplaces into high performance organizations.[2] As Secretary of Labor, Robert B. Reich, acknowledges, "The real economic challenge facing the United States in the years ahead . . . is to increase the potential value of what its citizens can add to the global economy, by enhancing their skills and capacities and by improving their means of linking those skills and capacities to the world market."[3]

The Advisory Panel for the Dictionary of Occupational Titles (APDOT), a Federal panel commissioned by the Secretary of Labor, has spent the past 2 years assessing the occupational information needs of the nation. The Panel has identified an essential role for the U.S. Department of Labor in assisting industry with skills identification and workers with skills acquisition by creating a new database system. To assure that *educators* can prepare students to meet the challenges of the 1990's and beyond; that *employers* can select, train, and place workers in jobs; and that *workers* can acquire the skills needed to achieve their career goals; new types of information and linkages among occupational databases are needed.

In short, a fundamental shift in the way we think about occupational information is required. The current DOT or *Dictionary of Occupational Titles* was first developed in the 1930's and is best known as a book that lists some 12,000 job descriptions or definitions in a narrative, fixed format. This dictionary concept must be replaced with the new *Database of Occupational Titles* that provides a flexible format and offers users computer-organized data that can be expanded, updated, and retrieved rapidly for various uses.

Data currently collected for the DOT describe the skills, knowledge, abilities, and traits workers need as well as the education and training requirements, the machines, tools, equipment and materials used, and the products produced. Such data descriptors are useful and their collection should continue. However, to support national efforts to revitalize the American economy, these descriptors must be supplemented with information that is necessary to revitalize the workforce.

APDOT has proposed new content for the DOT that will describe skills across a broad continuum from very general aptitudes, abilities and basic skills to occupation-specific and technical skills and knowledge. The new content is intended to help capture data on the increasingly cognitive demands of jobs and the new ways of thinking and managing that focus on quality, variety, speed, and customer service—hallmarks of productivity and competitiveness in the workplace.

Moreover, today's DOT, consisting of a patchwork of information on tasks, worker traits, activities, and characteristics must be integrated into a coherent system. A new database system that highlights connections between occupations, emphasizes skills transferability and links easily with related databases of education and labor market information is essential for the human resource management of the American economy. Today's students, educators, trainers, counselors, and workers need information that fosters the effective integration of technology, skills, and new workplace structures. The development

and maintenance of a coherent database system helps fulfill Department of Labor responsibilities for facilitating the match between workers and jobs and for collecting and disseminating data on labor supply and demand as well as on economic, industrial, and technological trends.

Specific differences between the current DOT and APDOT's recommendations for the future DOT are highlighted in figure A: Comparison of the Current and Future DOT, p. 213.

APDOT charter

Chartered under The Federal Advisory Committee Act, APDOT was asked to recommend to the Secretary of Labor strategies for collecting, analyzing, and disseminating occupational information. The Final Report, ***The New DOT: A Database of Occupational Titles for the Twenty-First Century***, presents the Panel's final recommendations. For a list of the recommendations presented in charter categories, see appendix D. While the report responds to the APDOT charter, the Panel views the report primarily as a strategic management tool for the Secretary of Labor and other policy makers to use in revitalizing the DOT. Specifically, the report fulfills the Panel's mandate to:

(1) Recommend the type and scope of coverage as well as the level of detail that should be collected on occupations to produce a DOT;

(2) Advise on appropriateness of methodologies of occupational analysis used to identify, classify, define, and describe jobs in the DOT;

(3) Advise on new or alternative approaches to the production, publication, and dissemination of the DOT; and

(4) Recommend options for implementation of improvements to the DOT.

A new DOT to serve a myriad of users

Through its review, APDOT came to understand the myriad ways in which the DOT is currently used and to see its critical role in increasing the productivity and quality of the workforce. Consider the following examples. Because all military service occupational classification systems are cross-coded to the DOT, it is the most powerful tool available for linking military and civilian occupations, a critical issue during current downsizing efforts. Similarly, human resource professionals in both the public and private sectors use the DOT to create or modify job classifications, to determine qualifications for selection tests, to establish skill and training requirements and to develop job training performance appraisals, career planning strategies, competency certification, and job design.

Department of Labor officials traditionally use the DOT in training, retraining, and placement programs especially within the Employment Service, Job Training Partnership Act, Job Corps, and Bureau of Apprenticeship and Training. The Bureau of Labor Statistics uses the DOT in its development of occupational and career information. The DOT also is critical to support planned workforce investment efforts such as career centers and youth apprenticeship.

The Social Security Administration identifies the DOT as a major source of information used to determine disability benefits for some 1 million cases per year.[4] Vocational rehabilitation practitioners use the DOT extensively to identify potential new occupations for persons with disabilities. The DOT is central to counseling and guidance in high school and beyond where it is used to identify transferable skills and to plan career options. For example, last year more than 4 million people used the State-supported Career Information Delivery Systems based on DOT data.[5] Other counseling tools that identify wage earnings and employment outlook also rely on the DOT.

The DOT is used in the nation's Foreign Labor Certifications program to identify jobs offered by employers and held by applicants in order to demonstrate eligibility to work in the United States. Curriculum developers in schools and training organizations use the DOT to match training objectives with descriptions of tasks and to modify curricula. Agencies involved in developing and reporting labor market information use the DOT as a core reference. Social science researchers have also made extensive use of its data in hundreds of studies of workforce participants.[6]

In proposing the recommendations that follow, APDOT recognizes these uses and is committed to assuring that the revised version will be even more useful. The Panel has recommended implementation strategies that phase in dramatic changes over time and assure users of continuity while the system is restructured. At the same time, because the Department of Labor is the funding source for the DOT, APDOT believes that the Department should assign its programs as top priority. The Panel believes that in revising the DOT to better meet its own information needs, the Department will also meet most needs of other DOT user groups.

APDOT's recommendations

Historically, the DOT was developed during the economic crisis of the 1930's as a tool to help the new public employment system improve linkages between skill supply and skill demand. The Panel believes that it is particularly appropriate for the DOT to be reinvented in the 1990's to serve the nation's current and future efforts to foster economic growth and competitiveness through skill acquisition and workforce investment.

What follows are the specific recommendations APDOT has proposed for the new DOT categorized according to the issues of purpose, database, data collection, dissemination, and implementation. For a full discussion of the individual recommendations, see chapter 2.

Purpose

The purpose of the *Database of Occupational Titles* (DOT) should be to promote the effective education, training, counseling, and employment of the American workforce. The DOT should be restructured to accomplish its purpose by providing a database system that identifies, defines, classifies, and describes occupations in the economy in an accessible and flexible manner. Moreover, the DOT should serve as a national benchmark that provides a common language for all users of occupational information.

Database

The scope of the DOT should cover all occupations in the U.S. economy.

The Department of Labor should use a single standardized occupational classification for the DOT and its labor market data collection programs. A single standardized classification will allow the DOT and other sources of occupational and labor market information to be technically and conceptually compatible.

The level of detail used in the DOT database should be sufficiently flexible to match the recommended standardized occupational classification, while allowing for further differentiation of occupations based on user needs and on the information collected.

The Department of Labor should adopt the APDOT "Content Model" as a framework for identifying the occupational information included in the DOT. The Content Model's specific descriptors or data elements should be developed as part of the implementation phase of the new DOT.

The Department of Labor should review every occupation detailed in the DOT at least every 5 years to assure that the DOT database remains current and that occupational data contained within it are updated regularly. Some selected occupations should be reviewed more frequently.

As the funding source for the DOT, the Department of Labor should appropriately rank its own program needs as the top priority. In meeting the Department's needs, APDOT also expects the occupational information included in the DOT to meet most of the needs of specialized users involved in workforce education, training, counseling, and employment.

Data collection

The Department of Labor should use sampling techniques in the collection of data for the DOT that ensure the representativeness of occupations and the accuracy and consistency of information. The sampling design should make use of existing empirical information on employment by occupation and on the location and industry of employers.

The Department of Labor should rely on the use of structured job analysis questionnaires as the primary strategy for data collection. Alternative methods may be used to supplement data collection when warranted.

The Department of Labor should collect occupational information using automated technologies to facilitate quality control and to achieve currency and accuracy in a cost-effective manner.

Dissemination

The Department of Labor should make a dynamic and flexible DOT database available in a variety of electronic, automated and hard copy formats to meet the varying needs of users involved in workforce development. The Department of Labor should invest in developing value-added applications as needed for its own use and where cost-effective. The Department should also continue to encourage the vendor industry to develop specialized, value-added applications. Moreover, DOT data should remain available to the public at the cost of reproduction or publication.

The Department of Labor should develop a continuing marketing campaign to educate and inform users about the DOT database, its content and its use.

Implementation

By the year 1996, the Department of Labor should develop a new, comprehensive, national database system that collects, produces, maintains, and disseminates accurate, reliable and valid information on occupations to support the Nation's workforce investment efforts. By 1994, the Department of Labor should develop a prototype database system that demonstrates the feasibility of new collection, analysis and dissemination strategies for target industries and occupations.

While focusing efforts on activities designed to produce a new DOT database system, the Department of Labor should maintain the existing DOT and develop interim products as appropriate.

The Department of Labor should commit to an ongoing research and development agenda to maintain the DOT database system's effectiveness over time.

The Department of Labor should assure that the staff and organization of its Occupational Analysis system reflect changes in the methods of data collection, occupational analysis and information dissemination required by the new DOT system. The Department should also sustain a commitment to recruit, train, and maintain a core staff of methodologically sophisticated professionals to manage the DOT program.

The Department of Labor should use the DOT as the foundation for related program efforts including the development of voluntary industry-based skill standards, the development of measures for assessing generic workplace skills and aptitudes and the proposed revision of the Standard Occupational Classification (SOC).

The Department of Labor should assure sufficient funding to develop the DOT database system. The Department

should also make a commitment to provide additional resources for enhanced operational requirements.

In conclusion, APDOT believes that the Department of Labor should reinvent the DOT in the context of the Administration's national economic investment strategy. In supplying critical information to support the effective education, training, counseling, and employment of workers, the new DOT can help America regain its competitiveness and revitalize the workplace, both now and into the twenty-first century.

Notes

[1] Governor Bill Clinton and Senator Al Gore. (1992). *Putting People First: How We Can All Change America.* New York, NY: Times Books, Random House.

[2] National Center on Education and the Economy. (1990). The Report of the Commission on the Skills of the American Workforce, *America's Choice: High Skills or Low Wages.* Rochester, NY: National Center on Education and the Economy.

John E. Hunter and Frank L. Schmidt. (1982). "Fitting People to Jobs: The Impact of Personnel Selection on National Productivity." in Edwin A. Fleishman (ed). *Human Performance and Productivity: Human Capability Assessment.* Volume 1. Hillsdale, NJ: Lawrence Erlbaum Associates.

[3] Robert B. Reich. (1992). *The Work of Nation's: Preparing Ourselves for 21st Century Capitalism.* New York, NY: Vintage Books, A Division of Random House.

[4] Testimony of the Social Security Administration to the Advisory Panel for the Dictionary of Occupational Titles by Joe Murphy, October 24, 1990. Washington, DC.

[5] Association of Computer-Based Systems for Career Information. (August 1991). *Use of the DOT by Career Information Delivery Systems.*

[6] National Research Council. (1980). *Work, Jobs, and Occupations: A Critical Review of the Dictionary of Occupational Titles.* Washington, DC: National Academy Press.

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Table A: Comparison of the current and future DOT

Current DOT	Future DOT
View of work reflects mechanistic, hierarchical structure of workplace.	View of work reflects restructured occupations; need for multi-skilled people.
Purpose to provide job matching for Employment Service.	Purpose to continue job matching and to support effective education, training, counseling and employment of workforce; purpose also to provide common language or benchmark for multiple users.
Scope includes all occupations but collection methods and resources limit coverage; predominance of blue-collar occupations.	Scope includes all occupations and reflects the actual composition of the labor market.
Uses classification system unique to DOT; Occupational Group Arrangement (OGA) requires complex crosswalks for linkage to other systems; uses nine-digit code for classification.	Uses a standardized occupational classification as primary classification method, facilitating direct linkage to other systems; capability for multiple classification approaches including skills.
Uses "Data-People-Things" to indicate level of complexity in jobs.	Uses new Content Model descriptors to reflect the multiple facets of job complexity.
Embeds skills information in the code, definitions and supplementary material.	Presents skills information directly in a broad continuum from very general aptitudes, abilities and basic skills to occupation-specific and technical skills and knowledge.
Patchwork of skills-related and other occupational information with both redundant and missing elements.	An integrated system that provides a common language of occupational information and a strong foundation for skills standards and assessment tools.
Content includes information on education and training requirements, machines, tools, equipment and materials used, as well as products produced.	Content redefines old descriptors and captures additional data on increasingly cognitive demands of jobs and new ways of thinking, working and managing that focus on worker attributes, work context, work content, and outcomes and labor market context.
Information on skills transferability not available.	Empirically-based skills transferability information.
Limited information for understanding career paths including job families.	New organization/structure provides information on job families.
Data collected through manual, labor-intensive procedures requiring on-site observation/interview.	Data collected primarily through automated survey procedures.
Currency of data problematic because of labor intensive data collection and analysis procedures.	Currency of data facilitated through new methodology.
Sampling procedures remain problematic.	Sampling techniques increase representativeness, accuracy and consistency of data.
Primary method of dissemination is book/database with fixed format; does not allow manipulation to meet user needs.	Primary method of dissemination is flexible database; allows for easy access and manipulation to meet user needs.
Developed independently within the United States Employment Service (USES), United States Department of Labor.	Developed in coordinated fashion among offices within the Department of Labor and outside users to support related skills and assessment initiatives, the collection of labor market information and the effective education, training, counseling, and employment of the workforce.

The Case for Revising U.S. Occupational Classification Systems

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Executive Summary

Occupational classification taxonomies in the United States support a wide range of important decisions, including career choices, disability assessments and alien labor certification judgments. Current occupational classification systems are often ill-suited for the intended purpose.

Most users of occupational information in the United States need to combine three things: (1) Accurate information about current job *requirements* (what workers do); (2) accurate information about the *qualifications* that are necessary to compete for these occupational opportunities (what workers need to know or be able to do); and (3) accurate information about *projected employment prospects* in these occupations.

A case is made here for consolidating occupational classification taxonomies in the United States. This case is balanced on two foundations. One foundation is *counting statistics*—figures that are reported in occupational cells. The other foundation is *transaction uses* (for example, career counseling or assessment and referral to job openings) each of which relies upon the three components of qualification, requirement and projected opportunity. The case for consolidation is developed using examples placed in historical and conceptual context.

The paper focuses on the *Dictionary of Occupational Titles* and the *Standard Occupational Classification Manual*. The DOT taxonomy was first released in 1939 to meet the day-to-day needs of local office personnel in State employment security agencies. A revised fourth edition was released in 1991. The SOC taxonomy first appeared in 1977. The perceived need was to establish a uniform federal standard for occupational classification. The intent was to require federal agencies to use the SOC taxonomy in the presentation of occupational statistics. The current taxonomy used in the Occupational Employment Statistics program of the Bureau of Labor Statistics, U.S. Department of Labor, offers one example of an occupational classification system that is similar to, but not fully compatible with, this SOC taxonomy. The 1991 revised fourth edition DOT describes nearly 13,000 occupations. The 1980 revised SOC manual collapses these into 663 occupational categories.

The 1991 *Dictionary of Occupational Titles* does not satisfy user needs with regard to the current job *requirements* and candidate *qualification* standards. Furthermore, incompatibilities in occupational classification taxonomies that appear in the Census, Standard Occupational Classification, Occupational Employment Statistics classification, and *Dictionary of Occupational Titles* classification, severely limit a user's ability to combine historical and projected occupational employment estimates with information about job requirements and expected employee qualifications.

A major goal of a coordinated DOT–SOC revision process will be to squeeze more value-added out of the combination of counting capability and definitional detail. The potential value-added that looms on the horizon appears particularly inviting this year, given the Clinton Administration's proposed initiatives to enhance the productivity of the Nation's workforce.

The transformation of potential value-added into an actual flow of benefits must involve collaboration between the Federal Government's primary producers of occupational employment *counting statistics* (the U.S. Department of Labor's Bureau of Labor Statistics and the U.S. Department of Commerce's Bureau of the Census) and the Federal Government's primary advocates on behalf of occupational information *transaction users* (the U.S. Department of Labor's Employment and Training Administration and the National Occupational Information Coordinating Committee).

Currently, two continuums of occupational information quality prevail—a *counting accuracy* continuum, and a *descriptive accuracy* continuum. A consolidated continuum of quality is proposed, which requires compromises between counting and descriptive priorities. Two possible alternatives to compromise are ruled out—(1) total consolidation of counting capability and descriptive elaboration, and (2) no consolidation of these two features (that is, the status quo).

The compromise proposed envisions a two-tier, partial consolidation, revision of occupational information taxonomies in the United States. Tier-one occupations would be selected for coverage in both counting and descriptive data collection activities. Transactions users could then be confident that the reported counts of actual or projected occupational incumbents can be associated

with the descriptors that are provided. Tier-two occupations would be considered for either counting or descriptive coverage, but not both.

Serious concerns would remain to be resolved. Reported occupational employment figures are derived from one set of establishment and household sources in a particular time pattern of collection and processing. Descriptors of job requirements and candidate qualifications are derived from different sources in a different time pattern of collection. This means that quality control audits would be required to assure that acceptable tolerances for these differences of origin are met.

Also, if descriptors drawn from a regularly updated database are associated with occupational employment figures derived from establishment and household sources, then the integrity of time-series data will be jeopardized.

Some tier-two (counting or descriptive coverage only) occupations might be retained for uses that are less demanding of precision in the representation of job requirement, candidate qualification or employment opportunity. The point here is that vendor or consumer combinations of such occupational information would be explictly recognized as "forced fits."

Once a preliminary assignment of occupations to tier-one or tier-two status has been accomplished, the burden-of-proof will lie with user-advocates who seek the elevation of a tier-two occupation to tier-one status, or the retention/creation of an occupational designation in tier-two. A value-added standard should be used in reaching a decision about such appeals. Why, for example, retain counts without descriptive content, or why describe without an ability to quantify in actual or projected employment terms?

Adoption of the proposed two-tier approach to consolidation of occupational information taxonomies in the United States would trigger an immediate need to develop criteria for assigning occupational categories to one of three segments of the occupational spectrum—(1) a consolidated counting and descriptive quality segment; (2) an either-or segment, which will allow "forced fit" combinations that will be clearly recognized as such; and (3) a "do not retain or introduce" segment. These criteria will simultaneously reflect and motivate the value-added calculus that will be involved.

The dialogue must continue between competing claimants on the Federal funds that might be made available for revising occupational classification taxonomies in the United States, which will pit counting accuracy advocates against descriptive detail advocates. Strong leadership will be required to guide this debate to a timely and stable resolution. Few steps along the revision path should be taken until this issue is addressed.

The implications of the case for a consolidated revision of occupational information taxonomies in the United States are straightforward. It would be shortsighted to proceed with aggressive investments in the development of skill standards, apprentice bridges between school and work, and renewal opportunities for displaced adults without providing an appropriate signal of Federal government commitment to the importance of occupational information as a beacon to light the way. At the same time, the Federal Government has an obligation to provide accurate occupational information in support of already existing programs.

The U.S. Department of Labor has been given leadership responsibility for creating a more productive workforce. One essential action in carrying out this assignment must be to renew the Employment and Training Administration's once strong commitment to collaborate with the Bureau of Labor Statistics to provide high quality and timely occupational information to those who affect, and those who are affected by, momentous decisions that determine life-chances, personal growth and well-being, and national pride and prosperity.

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Introduction

An inspection of our Nation's sources of occupational information reveals important deficiencies. Our occupational classification taxonomies support a wide range of important decisions, including career choices, disability assessments, and alien labor certification judgments. These occupational classification systems are often ill-suited for the intended purpose.

Most uses of occupational information follow a similar pattern—a person's qualifications are compared with job requirements in a context of projected opportunity. These three seemingly straightforward components of use—qualification, requirement, and need—are deceptive. It is not easy to combine any two of the three. It is particularly difficult to combine all three. Yet, all three must be combined in most uses of occupational information.

Consider the following scenario. Your daughter is being encouraged by her high-school biology teacher to consider a career in the biological sciences. During a scheduled meeting with her counselor, the *Dictionary of Occupational Titles* [1] is brought out. Turning to the section titled "Occupations in Biological Sciences," you are shown 28 occupational titles and definitions. These

include biologist, pharmacologist, zoologist, and herbarium worker.

You note that the date-of-last-update for 22 of these 28 occupational definitions was 1977, so you ask the counselor whether this is the most recent information that is available. The counselor pulls a copy of the *Occupational Outlook Handbook*[2] from a shelf, and you read that "biological scientists held about 62,000 jobs in 1990. In addition, about half as many held biology faculty positions in colleges and universities." You also read that "advances in basic biological knowledge, especially at the genetic level, have given rise to the new field of biotechnology."

Your daughter expresses particular interest in possible career opportunities in biotechnology. You ask how many of the estimated 62,000 biological scientist jobs in 1990 were in this emerging specialty. Reference to newly available 1990 census data is disappointing—all "biological and life scientists" are grouped together in a single occupational category.

Unable to acquire a more precise understanding of job opportunities in the biotechnology field, your daughter asks what preparation is required to become a "biological or life scientist." Referring back to the *Dictionary of Occupational Titles*, the counselor finds that the 28 occupations in biological sciences indicate a preparation time ranging from "over 6 months up to and including 1 year" to "over 10 years." You ask whether this means years of schooling, and are told that it includes any combination of vocational education, apprenticeship training, in-plant training, on-the-job training, and essential experience in other jobs.[3]

By now, your daughter is confused and frustrated.

Recalling the past year's rhetoric about the importance of the Nation's workforce competencies, is it possible that so little can be said about career opportunities in such an important field? Yes, it is possible, for this and most other sectors of the economy.

It is not easy to obtain accurate information about job requirements.[4] It is difficult to acquire up-to-date information about how people qualify to enter many occupations. And, even when information about requirement and qualification is available, it often is impossible to determine what opportunities are projected to be available for those who choose a particular career path.

This paper builds a case for consolidating U.S. occupational classification systems. Like a catamaran, this case rests on twin hulls. One foundation is *counting statistics*—figures, such as census data, that are reported in occupational "cells." Published occupational figures mask within-cell differences that cannot be detected in a practical way using today's collection methods and classification systems.

The other foundation is *transaction uses*—such as career counseling, assessment and referral to job openings, and alien worker certification, each of which relies upon the three components mentioned earlier (personal qualification, job requirement, and projected opportunity).

Today's hulls don't match. The occupational information vessel is not seaworthy. This isn't surprising. Independent design teams, with different specifications, worked on each hull. Therefore, this paper also builds a case for future collaboration between the Federal agencies that have primary responsibility for counting statistics and transaction uses, respectively.

The case for consolidation and collaboration is built through a series of examples placed in historical and conceptual context. We begin with some basics—brief descriptions of the *Dictionary of Occupational Titles* (DOT) and Standard Occupational Classification (SOC) systems.

The 9-digit Dictionary of Occupational Titles taxonomy

The first edition of the DOT appeared in 1939. It was created to meet the day-to-day needs of local office personnel in State Employment Security Agencies, who record the qualifications of job-seeking registrants and the requirements of employers who submit job orders. This first edition contained approximately 17,500 occupational definitions.

A second edition of the DOT was released in 1949, providing first-time coverage of new occupations that had emerged during and immediately after World War II. A third edition appeared in 1965. It substituted the current "nature of the work performed" classification criterion for a previous three-tier pyramid of skill level.[5] A fourth edition was published in 1977. It introduced several thousand new occupational definitions and modified others based on extensive job analyses. Two supplements to this fourth edition, which appeared in 1982 and 1986, continued the effort to provide up-to-date modifications and additions of occupational descriptions. A revised fourth edition, released in 1991, consolidated the 1977, 1982, and 1986 releases, and provided additional definitional revisions. Currently, this revised fourth edition contains 12,741 occupational base titles and definitions.

The first three digits of a DOT code indicate an occupational group. The first digit represents nine "categories," the first two digits together represent 83 occupational "divisions," and the first three digits together represent 564 "groups." For instance, the three-digit DOT code 816 appears in the one-digit occupational category 8—"structural work occupations;" in the 2-digit occupational division 81—"welders, cutters, and related occupations;" and in the 3-digit occupational group 816—"thermal cutters and arc cutters."

The next three digits of a DOT code represent three Worker Function ratings of the tasks performed in an occupation—how an employee's responsibilities translate into data, people, and things relations (for example, comparing, compiling, or synthesizing *data*; helping, super-

vising, or mentoring *people*; and handling, driving-operating, or setting up *things*.)[6] For example, DOT code 816.364—arc cutter, requires compiling, speaking-signalling, and manipulating; while DOT code 816.482—thermal-cutting machine operator, requires computing, taking instructions-helping, and operating-controlling.[7]

The last three digits of a nine-digit DOT code represent a specific occupational base title.[8]

The 4-digit Standard Occupational Classification taxonomy

Even before the first edition of the DOT appeared in 1939, work had begun on providing a translation "bridge" between this new occupational classification system and the 1940 census classification that would be used to organize the counting statistics that were about to be collected.[9]

Coincident with the appearance of the third edition DOT in 1965, the then Bureau of the Budget conducted an interagency survey that sought opinions on the need for a Standard Occupational Classification. The key word here is "standard." The perceived need was to establish a uniform Federal standard for occupational classification, which would be comparable to the Standard Industrial Classification taxonomy. The intent was to require Federal agencies to use the proposed SOC taxonomy in the presentation of occupational statistics.[10]

Over the next decade, largely independent workgroups assembled the components of what would become the first SOC taxonomy, which was released in 1977. The workgroups had access to valuable reference materials, including the deliberations of the government-wide committee that designed the 1970 Census occupational classification system,[11] Canada's *Classification and Dictionary of Occupations* that was first published in 1971,[12] the civil service classification, and the National Science Foundation's classification of occupations in the sciences.

The resulting taxonomy[13] includes four levels: 22 divisions, 62 major groups, 214 minor groups, and 537 unit groups. Each of the 1977 fourth edition DOT base codes appears under one SOC major group, minor group, or unit group.

The level of detail provided is uneven.[14] For example, 10 percent of the unit groups (54 out of 537) are machine operators and tenders, while only 2 percent (13 out of 537) are technologists and technicians. The SOC division level category *Health* Technologists and technicians contains just one major group, six minor groups,[15] and no unit groups. All 13 of the technologist and technician unit groups referred to above appear in a different SOC division—"technologists and technicians, except health." This contrasts with the SOC division level category "production working occupations," which provides five major groups, seven minor groups, and 104 unit groups (more than half of which are the 54 machine operator and tender occupations referred to above).

Health technologist and technician jobs, and machine operator and tender jobs, have changed since the 1980 *Standard Occupational Classification Manual* was released. Each offers a compelling example of why it is time to revisit the SOC taxonomy.

Transaction uses of available occupational information, which range from career counseling, through disability determination and vocational rehabilitation planning, to alien labor certification, require more than a balanced representation of today's occupations. Also needed are updated descriptions of the requirements of these occupations, and of the qualifications[16] that are necessary to be hired, retained and promoted. It is time to revisit the DOT taxonomy, too.

The Need to Consolodate U.S. Occupational Classification Systems

The 1991 revised fourth edition DOT describes nearly 13,000 occupations. The 1980 revised SOC manual collapses these into 663[17] occupational categories. If the DOT occupations were distributed evenly among these SOC categories, then 19 DOT occupations would appear in each of the SOC's occupational cells.[18]

The need for consolidation is illustrated with two examples. One example focuses on the difficulty that is encountered in trying to use occupational employment trend estimates for career counseling purposes. The second example looks at the problems that arise in trying to extract useful information about required competencies from available counting statistics. These are simply different perspectives on the fundamental problem that was identified at the beginning of the paper—the barriers that are encountered in trying to combine information about job requirements, candidate qualifications, and employment opportunity.

Example one

The 1980 *Standard Occupational Classification Manual* contains unit group 1636 computer engineers, which displays three DOT occupations.[19] None of these three DOT codes appears in the 1991 revised fourth edition *Dictionary*. Instead, the 1991 *Dictionary* presents a new division 03 computer-related occupations, which contains five new three-digit occupational groups.[20]

An alert user might be persistent enough to discover that one of the new three-digit occupational groups contains 9-digit occupational code 033.167–010. This 9-digit code displays a base title of computer systems hardware analyst. Alertness is required because three alternate titles are listed in lower-case print after the bold upper-case base title. One of these alternate titles is computer systems engineer.[21]

Can the 1991 *Dictionary's* descriptions of requirements and qualifications[22] for code 033.167–010 be combined

with germane information about relevant occupational employment trends? The next four pages reveal how difficult it is to combine information about job requirement, candidate qualification, and employment opportunity.

The Division of Occupational Outlook, Office of Economic Growth and Employment Projections, Bureau of Labor Statistics, in the U.S. Department of Labor, prepares occupational projections using a six-step approach that begins with estimates of population and labor force participation rates, the size of the labor force, and assumptions about the Nation's aggregate economy, to produce industry-specific final demand estimates. These estimates are then used to drive an input-output model to derive industry-specific output estimates. These estimates, in turn, are used to derive industry-specific *employment* estimates, which are combined with occupational staffing pattern figures in an industry-occupation matrix to finally derive occupational employment estimates.[23] The Bureau's Occupational Employment Statistics (OES) program compiles the occupational staffing pattern information in cooperation with State Employment Security Agencies. A survey of establishments is conducted over a recurring three-year cycle, which covers the Nation's major industry sectors. This core source of information about wage and salary workers is supplemented by information about the self-employed that is collected in the Current Population Statistics program, and by other sources of occupational employment data.

The occupational designation of computer engineer was introduced as a new OES survey category in 1989. The 1989 version of the OES survey's 3-year cycle covered the mining, construction, finance, and services sectors. In the previous 2 survey years of 1987 and 1988, computer engineers were "hidden" within the then-existing alternative occupational categories of electrical and electronic engineers, and systems analysts and other engineers.

The Office of Employment Growth and Employment Projections in the Bureau of Labor Statistics published a 1990 occupational employment estimate of 346,855 other engineers. This includes an undisclosed number of computer engineers. This published category, other engineers, is a summation of seven occupational categories that are identified individually in the Bureau's industry-occupation matrix. These seven occupational categories are: Agricultural engineers, all other engineers, computer engineers, engineers, marine architects, marine engineers, and safety engineers-except mining.

It is possible, if one has access to the information maintained by the Bureau, to derive an estimate of employment for the occupational category computer engineers.[24] But, even if this step is successfully completed, there is still no direct link between this employment estimate and the *Dictionary's* descriptors of the occupational requirements for computer engineers, or with the *Dictionary's* descriptors of the qualifications that are needed to become a computer engineer.

Recall that the 1980 *Standard Occupational Classification Manual* lists three DOT codes and titles for SOC unit group 1636 computer engineers, none of which was retained in the 1991 *Dictionary*. A cross-reference between the Occupational Employment Statistics program codes and the 1991 DOT codes provides some help. Two DOT occupational base codes and titles appear under the OES category 22127 computer engineers: DOT code 030.062–010 software engineer, and DOT code 033.167–010 computer systems hardware analyst.

Based on nothing more than the brief description of the 9-digit DOT taxonomy that was provided earlier in this paper, the following observations can be made.

- Both occupations appear in the same 2-digit DOT occupational division—computer-related occupations.
- The 3-digit DOT occupational group 030 includes occupations in systems analysis and programming.
- The 3-digit DOT occupational group 033 includes occupations in computer systems technical support.
- The 3-digit representation of work functions—the data, people, and things digits—indicates requirements of synthesizing, speaking-signalling, and operating-controlling for the software engineer occupational group, and coordinating, speaking-signalling, and handling for the computer systems hardware analyst occupational group.

We have no direct way to decide how to allocate a projected employment estimate for computer engineers between these two occupational groups. This is a serious limitation from a career counseling standpoint. The specific vocational preparation (SVP) designations for these two occupations are different, "more than 2 years up to and including 4 years" for the computer systems hardware analyst, and "more than 4 years up to and including 10 years" for the software engineer. The Guide for Occupational Exploration codes that have been assigned to these two occupations are different—with the first two digits indicating a "mechanical" interest area for a computer systems hardware analyst, and a "leading-influencing" interest area for a software engineer.[25]

This example reveals how difficult it is to combine the DOT's descriptive detail with the OES program's projection of future employment opportunity. From a transaction user's standpoint[26] access to either one alone is like trying to pilot a catamaran with only one hull.

The following barriers to a smooth combination of the three requirement, qualification, and opportunity components have been identified here:

(1) The 1980 *Standard Occupational Classification Manual* does not provide an accurate list of currently available occupational codes, titles and

descriptors that are found in the 1991 *Dictionary of Occupational Titles.*

(2) The 1991 *Dictionary* provides occupational descriptions that were last updated at different times between 1977 and 1990. Many of these descriptions were last updated in 1977. This is not considered to be "current" information by many transaction users of the information (for example, career counselors).[27]

(3) The Bureau of Labor Statistics' Occupational Employment Statistics program does not provide published occupational employment projections at a level of detail that is consistent with the *Dictionary's* occupational groups, and occupational base titles and descriptions.

(4) The Current Population Survey, and the decennial Census, are household surveys. These are relied upon for information about the self-employed, unpaid family workers, and wage and salary workers in agriculture, forestry, and fishing-hunting-trapping. Each provides less occupational detail than is possible through the establishment-based Occupational Employment Statistics survey.[28]

The first barrier mentioned above is trivial. It would be a straightforward task to list all of the DOT codes that have been created since 1977 in a new edition of the SOC *Manual*; particularly since an SOC code has already been assigned to each of these DOT codes (see endnote 11). But, remember that the SOC taxonomy is the Federal Government's standard for occupational classification. The SOC taxonomy itself cannot be changed without extensive interagency consultation. So, if today's computer-related occupations don't "fit" smoothly into an occupational classification taxonomy that hasn't been updated in 14 years, then a more complicated revision process must be considered. This is why "it is time to revisit the SOC taxonomy."

The second barrier, date-of-last-update of the *Dictionary's* occupational descriptions is the reason many experts advocate a "database" approach to revising the DOT's occupational descriptions. Today's electronic transmission capabilities would permit routine updating of occupational descriptions as new information is collected.[29]

The third barrier, incompatible occupational categories used in the presentation of occupational employment trend estimates and the *Dictionary's* descriptions of tasks and qualification requirements, highlights an inevitable tension among three considerations: (1) Limitations on the accuracy of occupational classification that arise when occupational information is collected;[30] (2) the level of aggregation, and related commitment of resources to data collection and processing, that is "satisfactory" to meet the needs of users of *counting statistics* only;[31] and (3) the level of aggregation, and related commitment of resources to data collection and processing, that is "satisfactory" to meet the needs of users of occupational information for *transactions* purposes. This inevitable tension is a primary justification for advocating a carefully orchestrated collaboration among the producers and users of occupational information in undertaking a consolidated revision of U.S. occupational classification systems.

The fourth barrier, an inability to accurately represent the self-employed, and other groups, at a level of aggregation that is useful for transaction users of occupational information, might seem to pale in importance relative to the second and third barriers that have already been examined.[32] Caution should be exercised in reaching a hasty conclusion about the relative importance of the self-employed. The decennial Census and monthly Current Population Statistics data collection programs provide most of what is known about the self-employed in the United States. These data sources support limited comparative analyses of the educational attainment of self-employed and wage-and-salary incumbents in available occupational categories. But, because of the other barriers that have been described here, these investigations provide limited help for career counselors.

A consolidated revision of the occupational category computer engineer would involve a determination of what level of detail can be collected in self-reporting, proxy respondent, household interview,[33] and establishment reporting settings; and what task requirement and employee qualification descriptors are needed to satisfy transaction user needs (for example, career counselors, job placement specialists, and alien worker certification personnel). More is said about these two criteria for a revision of U.S. occupational classification systems in a later section of this paper.

Example two

The previous section focused on the current inability to align counting statistics derived from the Census, Current Population Statistics, and Occupational Employment Statistics programs, with requirement and qualification descriptors that appear in the 1991 *Dictionary of Occupational Titles*. This second example adopts a different perspective to highlight a complementary reason why a consolidated revision of occupational classification taxonomies is needed. Currently, quite different combinations of task requirement and employee qualification are hidden beneath the surface within available counting statistics "cells."[34]

No one disagrees with the principle of within-group homogeneity, and its corollary of between-group difference. The important question is "homogeneous with respect to what?"[35] The Bureau of Labor Statistics[36] describes the problem.

> Even with the knowledge of what SOC category a DOT occupation is in, users may not be able to relate the characteristics information from that DOT to specific SOC categories in many cases . . . *[W]hen the*

DOT occupations equivalent to an SOC occupation contain heterogeneous job characteristic information (educational development, training requirements, language and math skills needed, physical requirements, etc.) there is no way to assign a characteristic at the SOC level (emphasis added).[37]

This example uses the 1991 *Dictionary of Occupational Titles* 2-digit occupational division 81 welders, cutters, and related occupations. This occupational division contains eight 3-digit occupational groups and 55 9-digit occupational base titles and descriptions.

At the outset of presenting this example a second illustration of the "aggregation problem" is provided. The 1980 *Standard Occupational Classification Manual* separates the 53 out of 55 occupations that are grouped together in the 1991 *Dictionary's* 2-digit division into three 2-digit major groups and six 4-digit unit groups.[38] The distribution of DOT codes among these six unit groups ranges from 23 (43 percent) in one of the SOC's unit groups to 4 (7½ percent) in another of the SOC's unit groups.[39]

This aggregation and uneven distribution of more detailed occupations might not affect some transactions users if accurate *Dictionary* descriptors are available that indicate similar requirement and qualification levels for the "hidden" occupations.[40] Unfortunately, this is not the case for the *Dictionary's* 2-digit division 81 welders, cutters, and related occupations.

A tabulation of the *Dictionary's* record of date-of-last-update reveals that 47 out of the 55 occupations in this division (85 percent) have not been updated since 1977. Only four have been updated in the past 5 years. Technological progress and changes in the organization of work that have occurred over the 15 years that have elapsed since the last update of the 47 occupations are cause for skepticism about the accuracy of the descriptors that appear in this division of the 1991 *Dictionary*.

Each of the occupational descriptions in the 1991 *Dictionary* includes a specific vocational preparation (SVP) level, which "is defined as the amount of lapsed time required by a typical worker to learn the techniques, acquire the information, and develop the facility needed for average performance in a specific job-worker situation."[41] This is a nine-level scale, which ranges from "short demonstration only" to "over 10 years."

The 55 DOT codes that are collapsed into two 1990 Census codes, and which are aggregated into three published OES categories, reveal the following distribution of specific vocational preparation (SVP) values.

10 DOT codes (18 percent)	"anything beyond short demonstration up to and including 1 month"
2 DOT codes (4 percent)	"over 1 month up to and including 3 months"
8 DOT codes (14 percent)	"over 3 months up to and including 6 months"
15 DOT codes (28 percent)	"over 6 months up to and including 1 year"
9 DOT codes (16 percent)	"over 1 year up to and including 2 years"
9 DOT codes (16 percent)	"over 2 years up to and including 4 years"
2 DOT codes (4 percent)	"over 4 years up to and including 10 years"

Think about how a career counselor might be expected to react to the first three observations in this occupational example—85 percent of the pertinent occupations were last updated 15 years ago; SVP values represent a composite of vocational education, apprenticeship training, in-plant training, on-the-job training, and essential experience in other jobs; and the recorded SVP values range from "anything beyond short demonstration to 10 years." Consider the technological and organization of work changes that have occurred in recent years[42] during this thought experiment.

The *Dictionary's* occupational division 81 welders, cutters, and related occupations provides an excellent example of one important aspect of the organization of work issue,[43] as it affects the design of an occupational classification taxonomy—there is growing documentation of a wedge being driven between technician and supervisory knowledge.[44] This has two implications for occupational classification.

First, it suggests that historical promotion paths from craftsperson to supervisory status are being severed. Supervisors often no longer understand, nor can they perform, many of the tasks required of their subordinates. New legitimacy criteria must emerge to replace the previous awareness that the supervisor had once been a peer. Mobility chains are alleged to have changed dramatically. Little, if any, of this is reflected in the 1991 *Dictionary*. Supervisor, inspector, machine setter, machine operator, production line welder/solderer/brazer, and apprentice occupational descriptions each appear with a date-of-last-update of 1977. Furthermore, in moving from the *Dictionary's* codes and titles to the Census or OES sources of historical and projected employment figures, all of these are grouped together.[45] The realignment of mobility paths is occurring at both ends of a seniority/responsibility continuum. The new Administration proposes to substantially alter the entry-level apprentice's role in the U.S. economy. This increases the urgency of updating and reclassifying these segments of workforce responsibility.

The second implication of the wedge effect for occupational classification is that the craft occupations themselves have evolved to require more self-reliance and discretionary responsibility. Each of the 12,741 occupational definitions that appear in the 1991 *Dictionary* in-

clude a "definition trailer."[46] Two components of this definition trailer have already been introduced above: date-of-last-update, and specific vocational preparation. A third component of this definition trailer is General Educational Development (GED).[47]

> General educational development embraces those aspects of education (formal and informal) which are required of the worker for satisfactory job performance. This is education of a general nature which does not have a recognized, fairly specific occupational objective. Ordinarily, such education is obtained in elementary school, high school, or college. However, it may be obtained from experience and self-study.

> The GED scale is composed of three divisions: Reasoning development, mathematical development, and language development.

The GED ratings of the 55 occupations in the *Dictionary's* division 81 welders, cutters, and related occupations are presented below. The reasoning development and mathematical development scales have six levels, with 1 representing the least demanding requirement and 6 representing the most demanding requirement. The language development scale only has five levels.[48]

Reasoning development			
	Level 4	20 DOT codes	(36 percent)
	Level 3	23 DOT codes	(42 percent)
	Level 2	12 DOT codes	(22 percent)
Mathematical development			
	Level 4	9 DOT codes	(16 percent)
	Level 3	27 DOT codes	(49 percent)
	Level 2	14 DOT codes	(26 percent)
	Level 1	5 DOT codes	(9 percent)
Language development			
	Level 3	33 DOT codes	(60 percent)
	Level 2	18 DOT codes	(33 percent)
	Level 1	4 DOT codes	(7 percent)

This distribution of GED levels provides a compelling example of how much occupation-specific descriptive content is lost when an attempt is made to combine the *Dictionary's* components with the *Standard Occupational Classification Manual's* aggregated classification of historical and projected employment figures.

Two additional observations warrant mention here. Continuing changes in the organization of work in the United States, which manifest themselves in the increased importance of employee self-reliance and discretionary authority, produce deep concern about transaction users of the *Dictionary* relying upon occupation-specific GED level requirements that were assigned 15 years ago (for 85 percent of the DOT codes in this example). And, the *Dictionary's* statement that "the description of the various levels of language and mathematical development are based on the curricula taught in schools throughout the United States"[49] raises questions about the accuracy of representation of candidate qualification that results from continued use of the current GED scales; given well-documented differences in student performance across the Nation's school systems.

This example has documented three more barriers that affect the ability of transactions users of the Nation's occupational information to carry out their professional responsibilities in an effective and efficient manner.

(1) The composite specific vocational preparation (SVP) component of the *Dictionary's* definition trailer exhibits substantial variance across DOT occupational categories that are aggregated within SOC occupations,[50] where this variance "disappears" from user accessibility.
(2) The three-part scaling of general educational development (GED) also exhibits substantial variance across the DOT's occupations that are grouped into SOC, Census, and OES classifications of historical and projected occupational employment levels. These occupation-specific differences are therefore "hidden" from user view.
(3) In many cases, it has been 15 years since these, and other descriptive components (for example, physical demands-strength ratings), have been updated.

The "lost variance" barriers arise when the *Dictionary's* occupational descriptors are hidden within less detailed occupational cells that are used in presenting historical and projected employment figures to the public. This is why immediate action to achieve compatibility of U.S. occupational classification taxonomies is endorsed.[51]

The consequences of the "outdated descriptive components" barrier are apparent to anyone who has made a decision, or influenced someone else's decision, based on currently available occupational information sources in the U.S.—whether this decision was with respect to a career path, a disability determination, a vocational rehabilitation plan, an alien worker certification judgment, a job referral opportunity, or a research investigation that might affect national policy.

The uneven pace of technological change across sectors of the U.S. economy, which has been accompanied by many sector-specific changes in the organization of work, combine to provide a compelling case that the *Dictionary's* current descriptive components are likely to be obsolete. This might have been acceptable in a less turbulent[52] period. It cannot be tolerated at a time when the Nation is about to embark on a new era of aggressive government investments in apprentice and displaced worker competencies.

A synthesis of the examples

Two, very different, occupations were selected to illustrate the barriers that arise in daily use of U.S. occupational information sources. The computer engineer example illustrates the rapidly changing occupational category of professional, technical, and managerial occupations. The welders, cutters, and related occupations example reflects the equally turbulent occupational category of structural work occupations.

These two examples represent the targets of two initiatives of the new Administration in the United States, which will affect U.S. Department of Labor priorities: (1) Increased investment in life-long learning, which addresses the needs of displaced workers; and (2) increased investment in apprentice "bridges" between school and work, many of which will affect future entry paths into the structural work occupations. These are not aberrant cases. Other examples could have been substituted for these two.[53]

The following lessons have been highlighted up to this point.

(1) Most users of occupational information in the U.S. need to combine three things: (1) Accurate information about current task requirements (what workers do); (2) accurate information about the qualifications that are necessary to compete for these occupational opportunities (what workers need to know or be able to do); and (3) accurate information about projected employment prospects in these occupations.

(2) The 1991 *Dictionary of Occupational Titles* does not satisfy user needs with regard to the first two of these three requirements.

(3) Incompatibilities in occupational classification that appear in the Census, Standard Occupational Classification, Occupational Employment Statistics classification, and *Dictionary of Occupational Titles* classification, severely limit a user's ability to combine historical and projected occupational employment estimates with information about job requirements and expected employee qualifications.

These facts, by themselves, constitute a strong case for revising U.S. occupational classification taxonomies. Additional reasons for acting now are provided in the following pages.

More Reasons to Begin the Revision Process

"Nature of the work performed" as a primary classification principle

Previously, in the second paragraph of page 3, it was noted that the 1965 third edition of the U.S. *Dictionary of Occupational Titles* introduced a "nature of the work performed" criterion for classification, as a substitute for earlier reliance on a three-tier hierarchy of skill level. There is not universal agreement that this is a practical classification criterion. For example, Brian Embury, a principal member of the team that created Australia's Standard Classification of Occupations (ASCO), asserts that "there is no commonly accepted operational interpretation of this concept and hence classifications which claim to be based on this criterion vary widely in their structures."[54]

A 1992 paper released by Michigan's Occupational Analysis Field Center[55] notes that:

> "The work performed components of the DOT are worker functions [data, people, and things], work fields, and materials, products, subject matter, and services (MPSMS). *The SOC does not define work performed, thus a consistent definition of work performed will be needed for a new, coordinated [occupational classification] system.* Although the classification principle of work performed applies to both the SOC and DOT, there are substantial differences between the systems. The current DOT separates occupations when the skill level, as indicated by worker functions GED, SVP, and other characteristics differ substantially. The current SOC has a hierarchy by skill level and groups some occupations in the same unit group that the current DOT considers to be at a substantially different level. Agreement will be needed on the work performed and/or descriptor factors which determine skill level, and how much similarity is required to assign occupations to the same group (emphasis added)."

The relevance of industrial affiliation[56]

The 1991 *Dictionary of Occupational Titles* continues a tradition of using a DOT-specific coding of industry.[57] If a revision goal is a compatible classification of U.S. occupations, then continued use of a DOT-specific industry designation should be questioned. The Standard Industrial Classification (SIC) taxonomy should be considered as a substitute approach.

Occupational "cell" size as a classification criterion

The 1991 *Dictionary's* 12,741 occupational definitions have been criticized for providing too many separate definitions for some occupational categories, and too few definitions for others.[58] Some experts have proposed that the Bureau of Labor Statistics' Occupational Employment Statistics program industry-occupation matrix should be used as one basis for assigning revision priorities to specific occupational "cells."

Value-added versus value-lost

Any substantial revision of the Nation's occupational classification taxonomies will simultaneously diminish the

value of some current government and proprietary products and services and create many new opportunities to pursue value-added ventures.[59] The time lapse between a decision to revise and the ultimate appearance of new compatible occupational classification taxonomies will provide ample opportunity for inventories of current products to be depleted, and for investments to shift in anticipatory directions.

A major goal of a coordinated DOT–SOC revision process will be to squeeze more value-added out of the combination of counting capability and definitional detail. The latent value-added that looms on the horizon appears particularly inviting this year, given the new Administration's proposed initiatives to enhance the productivity of the Nation's workforce.

The transformation of latent value-added (a hypothetical quantity) into an actual flow of benefits must involve collaboration between the Federal Government's primary producers of occupational employment *counting statistics* (the U.S. Department of Labor's Bureau of Labor Statistics, and the U.S. Department of Commerce's Bureau of the Census), and the Federal Government's primary advocates on behalf of occupational information *transaction* users (the U.S. Department of Labor's Employment and Training Administration, and the National Occupational Information Coordinating Committee).

A long list of potential beneficiaries could be compiled. A short list of those who will produce the value-added data, if they are given access to higher quality occupational information than now exists to support their activities, includes career counselors, job placement personnel,[60] certification specialists, attorneys, advocacy groups, researchers, evaluators, planners, and managers.[61]

Up to this point, ad hoc examples of "transaction users" of occupational information have been introduced. The case for revising U.S. occupational classification systems is advanced in the next section by focusing on four "hot" initiatives—(1) the development of national skill standards and refinement of competency measurement instruments; (2) the refinement of occupational information system (OIS) and labor market information (LMI) content and availability; (3) improvement of disability determination and vocational rehabilitation assessment and counseling services; and (4) progress in carrying out alien worker certification procedures in a timely and fair way.

Use-Specific Reasons to Act Now

Skill standards and competency measurement initiatives

The U.S. Department of Labor and U.S. Department of Education recently commissioned 12 industry projects to demonstrate whether, and how, skill proficiency standards and measurement systems can be established for selected occupations within the chosen industries.[62] If one or more of these demonstrations develops a prototype for routine adoption, then the career and vocational counseling community will want to combine evidence of occupation-specific imbalances in supply and demand flows with definitional detail reflecting current and projected job requirements and employee qualification expectations.

Skill proficiency standards inevitably reflect recent supply-demand dynamics. The qualifications of employees in "world class" enterprises are both a cause and an effect of the leadership designation. Incumbent qualifications are likely to be higher than the threshold requirement necessary to extract the same level of productivity—everybody loves a winner. However, from a career and vocational counseling perspective, it is necessary to project what qualifications will actually be required in a time- and place-specific context that is appropriate for a particular client. Credible projections of occupational employment and of the component descriptors of these occupations will be equally important for these users of occupational information. It would be unconscionable to proceed with initiatives of this kind without improving the management information that is available to allocate the new resources.[63]

Labor market information (LMI) and occupational information system (OIS) refinements

The *Dictionary of Occupational Titles* has been of little relevance for the LMI community in the past, because of the inability to combine the descriptive richness of the DOT with the essential ability to distribute historical and projected employment estimates by these codes. Much of the speculation about structural changes in the U.S. economy, and what these changes mean for particular groups, has relied upon assembled data sources that are often poorly suited for the application.[64]

The proposed apprentice, skill standards, displaced worker, and life-long learning initiatives raise the stakes for those who manage the Nation's public and private LMI and OIS activities—the payoff to providing timely and accurate information will be higher than ever before, but so will the costs of inaction. The implication is clear; act quickly.

Disability determination and vocational rehabilitation

The Americans With Disabilities Act of 1990 (ADA) requires affected employers to make reasonable accomodations to permit individuals with disabilities to compete for positions if they can perform the *essential functions* of the position.[65] This increases interest in the position-specific differences that are masked in the DOT's aggregation of on-site job analyses to occupations.

Even before the ADA's position-specific requirements, there has long been a need to assess the extent and consequences of a loss of occupational capacity. Assessment of the "extent of loss of occupational capacity"

requires accurate information about the essential tasks that must be performed, and the discretionary tasks that might be transferred to another employee if they cannot be performed by the person whose diminished occupational capacity is being assessed.

The determination of "loss of occupational capacity" is the first step of a two-step assessment process. The second step is to devise a vocational rehabilitation plan. This requires a direct blending of knowledge about the DOT's definitional components with employment estimates for occupations that display the relevant values of these factors. Such information is not currently available in the United States. It doesn't matter how many similar employment opportunities have been lost in the first step "loss of occupational capacity" determination. But, when rehabilitation need is on the table, a credible estimate of projected occupational employment possibilities should be available to those who must decide what action to take.

None of the U.S. occupational classification taxonomies is intended to provide the position-specific detail that is required by a disabled client's vocational rehabilitation counselor. However, compatibility of these occupational classification taxonomies would permit such counselors to combine estimates of future occupational employment opportunities with the essential descriptors of task and employee qualification requirements. This combination of the three fundamental components of transaction use is not possible today.

The Americans With Disabilities Act of 1990 created a unique criterion for occupational classification in the United States. This provides an impetus for revision that is not found in other countries. At the same time, it presents an opportunity to demonstrate to the international community how a truly pioneering advance of occupational classification taxonomies can be accomplished.

Alien worker certification

This use of occupational information combines information about candidate qualification and employer requirement in a place-specific context, which is a detail-intensive application. The precision of classification is crucial to the determination of certification eligibility. The certification decision depends upon the absence of evidence of other available qualified resident candidates for the position, and upon documentation that the compensation offered is consistent with the prevailing level in the particular local labor market. Any redefinition of current occupational classification taxonomies will affect the alien labor certification procedure.[66]

This transaction use of occupational information is particularly interesting because the documentation of candidate qualification comes from non-U.S. sources in most cases. This means that the alignment of job requirement and candidate qualification is even more difficult than it is for students who are emerging from the Nation's diverse school systems, or for displaced workers who have varied work histories with poorly documented formal and informal work-based learning records.

From compelling problem to a proposed response

Up to this point, evidence has been assembled to make the case for updating and increasing the compatibility of the Nation's occupational classification taxonomies. This case has used examples of our current inability to combine information about job requirements, candidate qualifications and employment opportunity—that is, to combine actual counts, or estimates, of occupational opportunities with descriptors of requirements that must be met to qualify for these opportunities and of candidates whose qualifications satisfy these requirements.

The next section explores actions that can be taken to advance the compatibility of occupational classification taxonomies in the United States. This section elaborates upon a theme that was expressed earlier in this paper—"*. . . to squeeze more value-added out of the combination of counting capability and definitional detail,*" (emphasis added).

Toward Compatible Occupational Classification Taxonomies

A conceptual framework for thinking about alternative approaches

Assume that the amount of money that will be available for revising and maintaining new occupational classification taxonomies in the United States is known. This simplifies matters here because it does not allow funding to be contingent on the approach that is promoted.

The availability of a known budget allocation forces us to think in terms of tradeoffs. All actions have cost consequences. Each decision to enhance one component of occupational information availability means that other features will be left alone.

Now, visualize a linear peg-board of all occupations in the United States, with *counting accuracy* at one end and *descriptive detail* at the other end. There are two rows of occupational pegs. In one row the occupational pegs nearest to the *counting accuracy* end of the peg-board exhibit the most accurate (timely and precise) information about employment opportunity in the represented occupations.[67] In the second row the occupational pegs nearest to the *descriptive detail* end of the peg-board exhibit the most comprehensive understanding of job requirements and candidate qualifications. Some occupational categories appear in both rows, but there are many empty holes in each of the rows. These empty holes indicate that no counting information, or no descriptive detail, is available for these occupational categories.

This peg-board metaphor highlights the fixed-budget tradeoff between these two features of occupational infor-

mation in the United States. The catamaran metaphor expressed this tension by identifying two competing interest groups—those who want accurate occupational employment figures (the counters), and those who want extensive descriptive information about these occupational employment cells (the transaction users).

Pursuit of a routine capacity to combine information about job requirements, candidate qualifications and employment opportunity can be thought of as rearranging the pegs on this *counting accuracy-descriptive detail* peg-board. However, all combinations along the peg-board are not accessible. There is an important constraint that has not been mentioned—there is a practical limit on the level of occupational detail that can be used in different data collection approaches.[68] Think of this limit as identifying one occupational peg somewhere along the board, which will serve as a "marker," or locked-gate, that cannot be passed. The location of this choice might be advanced toward the *descriptive detail* end of the board by increasing the budget for data collection, but a decreasing marginal returns phenomenon would be expected to limit the range of possible advance in this direction.

Another important feature of this occupational peg-board should be revealed. The location of each occupational peg on the board is not predetermined. Given a known budget allocation, and cost estimates for different mixes of data collection approaches, it is possible to derive an estimate of *how many* occupational employment estimates can be provided. However, this does not reveal *which* occupational incumbents are to be covered.[69] The peg that serves as a locked-gate only determines how many occupational categories can be covered in the counting statistics, not which occupations are covered.

Placing SOC and DOT occupational pegs on a new board

Currently, two different quality continuums (rows of occupational pegs) appear on the United States' occupational peg-board. One continuum of quality (row of pegs) records *counting* accuracy. A second continuum of quality (row of pegs) records *descriptive* accuracy. A third continuum of quality can be created by combining each of these. However, again, an important constraint must be acknowledged—relatively few "clean" combinations exist. The examples presented earlier in this paper document the problem. Even the "clean" combinations that can be accomplished are artifacts of past decisions that may bear little relevance to today's needs and to future priorities.

Consider, then, moving occupational pegs from the current board to a new peg-board that has only one row of holes. On this new board there is only one continuum of quality—a combination of counting accuracy and descriptive detail. Since some occupational categories are currently represented by two pegs—one that indicates the quality of counting measurement, and a second that measures the quality of descriptive detail, a decision-rule must be established for this substitution of a single quality priority for the previous two (see below). Many occupational categories are currently represented by only one peg—*either* a counting continuum peg, *or* a descriptive detail peg; but not both.

Some pegs will be moved as is (that is, their definitions will not be changed), albeit to a different position in many cases. Some, perhaps many, occupational pegs will be left behind. New occupational pegs will be designated; sometimes as substitutes for combinations of those that are to be left behind.

Decision-rules are needed. Two possible decisions are ruled out here.

(1) *Full Consolidation* (of counting capability and descriptive elaboration), which is ruled out because of the high costs and limited benefits that would result from this approach. The accuracy of data collection constraint would combine with a plausible estimate of available funds to limit the number of occupational categories to a level that would be unacceptable to current users of counting statistics or to transactions users. Consider two ways in which full consolidation might be attempted.
   (a) Provide for a *small* increase in the number of occupational counting cells (from the current level of 775 Occupational Employment Statistics survey categories, plus the Current Population Survey and decennial Census categories that are relied upon) combined with a *drastic* cut in the *Dictionary's* number of occupational descriptions.
   (b) Provide for a *major* increase in the number of occupational counting cells combined with a *major* decrease in the number of *Dictionary* occupational descriptions.

   It is unlikely that either of these approaches will attract widespread support. The first will be resisted by transactions users, and perhaps by some vendors of *Dictionary*-dependent products and services (although other vendors will see an opportunity here). The second will be resisted by the agencies that are responsible for collecting occupational employment data, who will question the ability to maintain appropriate quality standards, and who will be skeptical of Congress' willingness to provide the necessary resources to carry out such an expansion.

(2) *No Consolidation* (of counting capability and descriptive elaboration), which is ruled out for the reasons that have been developed throughout this paper—transaction users require information about employment opportunity, job requirement and candidate qualification. There are many uses of count-

ing statistics that do not require descriptive elaboration, but there are few, if any, transaction uses that do not require some measure of employment opportunity.

A third, compromise, approach is likely to receive widespread endorsement.

(3) *Partial Consolidation* (of counting capability and descriptive elaboration), which would result in a two-tier production of occupational information in the United States.

(a) *Tier One*. Occupations would be selected for coverage in both *counting* and *descriptive* data collection activities. Possible criteria for choosing such occupations are introduced below. Transactions users could be confident that the reported counts of occupational incumbents can be associated with the descriptors that are provided. Serious concerns remain to be resolved if this approach is to be recommended for adoption by the Federal Government.

(1) The counts of occupational incumbents are derived from one set of establishment and household sources in a particular time pattern of collection and processing, and the descriptors are derived from different sources in a different time pattern of collection. This means that quality control audits would be required to assure that acceptable tolerances for these differences of origin are met.

(2) To the extent that descriptors drawn from a routinely updated database of occupational information are associated with occupational employment counts, the integrity of time-series data will be jeopardized.[70]

(b) *Tier Two*. Remaining occupations would be considered for *counting* or *descriptive* coverage, but not both. A rigorous review of these occupational categories would be undertaken with two objectives.

(1) Some occupations that did not make the cut for truly consolidated coverage in both counting and descriptive respects might be selected for counting or transaction uses that are less demanding of precision in the representation of job requirement, candidate qualification, or employment opportunity.[71]

(2) Other occupations that did not make the cut for consolidated coverage, or even for less-precise applications that require both counting coverage and descriptive representation, might warrant continued attention. The burden of proof in this case lies with the users of such information—why retain counts without descriptive content, and why describe without an ability to quantify in employment terms?

Criteria for assigning occupational classification priorities

A chicken-and-egg dilemma arises here—it would be nice to have better information to support the decisions that must be made to improve the quality of available occupational information in the United States!

The *size of an occupational employment cell* is one obvious criterion to consider for deciding whether an occupation should be elevated to the proposed new pegboard's consolidated segment. This is the preferred assignment in the Nation's future occupational classification taxonomies. It means that an occupation is thought to be important enough to invest in acquiring accurate information about job requirements, candidate qualifications, and employment opportunities. The problem is that the current, often incompatible, occupational classification taxonomies do not allow us to determine the current or projected employment levels for many occupations that might be considered to be candidates for this elevated status in a new consolidated taxonomy.

This is just one manifestation of the difficulty that arises in trying to calculate the value-added payoff to specific choices of occupations that would be given preferred status in the new consolidated occupational taxonomy. It is somewhat easier to establish rankings of priorities within use-specific applications of occupational information than it is to compare across these rankings. And, even within a given use-specific ranking, it is difficult to apply such metrics as "twice as important."

High school career counselors seek accurate counting and descriptive information about entry-level opportunities, but with what geographic and time parameters? And with what combinations of high school curriculum, competency attainment, postsecondary educational pursuit, and coincident or sequential work-based learning?

Counselors of adults who have lost their jobs, or who are in real or imagined jeopardy, seek related, but somewhat different occupational information. They want to know more about school-based and work-site learning opportunities, both separately and as packages. They want to know more about how previous employee responsibilities might be used in a new work setting.

Both of these types of counselor want to know about mobility paths beyond the entry-level gate into new employment. What are the prospects for promotion, and what can be done to enhance these prospects? How can clients protect themselves from the threat of layoff; or, once separated, improve their likelihood of finding another job quickly?

Another criterion for selecting preferred occupational categories for consolidation is the *probability of multiple uses* of the improved data. This would inevitably require the implicit or explicit assignment of relative importance to particular uses of occupational information.

Required actions

It seems unlikely that available funds will be concentrated on consolidated occupational categories alone, although substantial attention to this effort is endorsed. Similarly, it appears to be unlikely that total inaction on the consolidation front will continue. This leaves the two-tier partial consolidation approach as the likely choice for Federal action.

Selection of the two-tier partial consolidation approach will trigger an immediate need to develop criteria for assigning occupational categories to one of three segments of the occupational continuum:

(1) The consolidated segment;
(2) A "retain for less precise forced-fit of counting statistics and occupational descriptors" segment; and
(3) A "consider for termination" segment.

Two such criteria, albeit imperfect ones, have been identified here:

(1) Current or projected estimates of occupational employment cell size; and
(2) Probability of multiple uses.

At the same early stage of the revision process, a start must be made on calculating net value-added estimates for particular assignments of occupational categories to each of these three segments. This will not be easy. Costs of data collection with respect to any one occupational category will be dependent upon decisions that are unlikely to be made this early in the process—such as technologies to be adopted, frequency of collection, quality control standards to be imposed, and cost-sharing prospects within the Federal Government, and between the Federal Government and other governmental levels, vendors and users of occupational information.

The dialogue about counting accuracy versus descriptive detail, between competing claimants on available funds, will be contentious. Strong leadership will be required to guide this debate to a timely and stable resolution. Few steps along the revision path can be taken until this issue is addressed and a decision is made.

Classification Problems, Consequences, and Implications

This paper has built a case for revising U.S. occupational classification taxonomies by documenting fundamental problems that arise from today's incompatible classification systems.

The case was then strengthened by providing use-specific examples of the consequences of these deficiencies. A diverse range of examples has been provided, covering national skill standards and competency measurement initiatives; labor market information and occupational information system shortcomings; disability determination and vocational rehabilitation needs; and alien worker certification regulations and procedures.

The implications of this case are straightforward. It would be shortsighted to proceed with aggressive investments in the development of skill standards, apprentice bridges between school and work, and renewal opportunities for displaced workers without providing an appropriate signal of Federal Government commitment to the importance of occupational information as a beacon to guide the way. At the same time, the Federal Government has an obligation to provide accurate occupational information in support of already existing programs.

The U.S. Department of Labor has been given leadership responsibility for creating a more productive workforce. One essential action in carrying out this assignment must be to renew the Employment and Training Administration's once strong commitment to collaborate with the Bureau of Labor Statistics to provide high quality, and timely, occupational information to those who affect, and those who are affected by, momentous decisions that determine life-chances, personal growth and well-being, and national pride and prosperity. Each of us has heard the sagas of military maneuvers that succeeded or failed based on the quality and timely availability of intelligence. Managers of non-military advances, too, must have better intelligence than their adversaries.

Notes

[1] Employment and Training Administration (1991), *Dictionary of Occupational Titles*, Revised Fourth Edition, Volume I, Washington, DC: U.S. Department of Labor, pp. 48–50.

[2] U.S. Department of Labor, Bureau of Labor Statistics (1992), *Occupational Outlook Handbook*, 1992–93 Edition, Bulletin 2400, May 1992, Washington, DC, pp. 89–91.

[3] *Dictionary of Occupational Titles* (1991), Volume II, appendix C: "Components of the Definitional Trailer," p. 1009.

[4] The *Occupational Outlook Handbook's* coverage of biological scientists includes a section titled "Sources of Additional Information," which lists the names and addresses for six professional associations (for example, the American Society for Biochemistry and Molecular Biology, and the American Society for Microbiology). Similar information is presented for each of the occupations that are highlighted in the *Handbook*.

[5] The director of the early research that was undertaken to develop the third edition of the *Dictionary of Occupational Titles* published his thoughts about the importance of the "nature of the work performed" criterion for classification. Sidney A. Fine (1968), The 1965 Third Edition of the *Dictionary of Occupational Titles*—Content, Contrasts, and Critique, Kalamazoo, MI: The W.E. Upjohn Institute for Employment Research, pp. 4–5, reports that (the first three digits of the third edition DOT code) "describes what gets done in the world of work. The second three digits classify people functioning in technology, that is, what workers do. This is the first major new development. Until the publication of the third edition of the *Dictionary*, all occupations were classified as though they were completely and totally dominated by technology. In the new *Dictionary*, the classification of people functioning is integral to the basic classification system—thus it is a classification of human involvement in work as well as of technology. This is a major change of great importance. People have been put back into jobs. Jobs are now job-worker situations. The full impact of this change is likely to take years to be appreciated fully—and also years to be developed further."

[6] The revised fourth edition *Dictionary of Occupational Titles*, Volume I, p. xix, reports that "as a general rule, Worker Functions involving more complex responsibility and judgment are assigned lower numbers in these three lists while functions which are less complicated have higher numbers." Karl F. Botterbusch (1992), "Suggestions for Revisions in the *Dictionary of Occupational Titles*." Menomonie, WI: Vocational Counseling Associates, p. 5, provides the following insights about the data, people, and things worker functions: (1) The data scaling is a single hierarchical continuum, the people scaling is not a hierarchy at all, and the things scaling is actually two hierarchies; (2) it cannot be assumed that the assignment of a lower number (that is, a "higher" rating) on any of these can be presumed to indicate competence at a higher number (that is, a "lower" rating); and (3) summations across these independent scalings are inappropriate. These cautions are not followed by many, even expert, users of the Dictionary.

[7] Actually, these were the requirements in 1977, which is the date-of-last-update for each of these occupations. Fifteen years of technological progress and reorganization of work settings have elapsed since these field observations were made.

[8] Combinations of the last three digits of a DOT code are sequenced in multiples of four, beginning with 010, alphabetically for those occupational base titles that existed when the fourth edition DOT was prepared in 1977, and sequentially thereafter for base titles that have been added since then. For example, DOT code 692.682 includes occupations in the fabrication of products from assorted materials, which require the worker functions of comparing data, taking instructions from and helping people, and operating-controlling things. Sixteen different occupational base titles and definitions appear in the revised fourth edition *Dictionary of Occupational Titles*, Volume II, pp. 669–670, for code 692.682. These range from 692.682–010 ankle-patch molder to 692.682–070 twisting-machine operator. Broken sequences of the "multiple of four" rule in the 1991 revised fourth edition *Dictionary* indicate that some occupational base titles that appeared in the 1977 fourth edition *Dictionary* have been deleted.

[9] See: Gladys L. Palmer (1939), "The Convertibility List of Occupations and the Problems of Developing It," *Journal of the American Statistical Association*, 34:208 (December 1939), pp. 693–708.

[10] The manager of the original SOC recalls, in personal correspondence addressed to the author dated February 1993, that "I wrote a directive that requires agencies to use the SOC in data collection programs, but also states that use of the SOC for programmatic use is at the discretion of the agency. I do not remember any opposition to the directive."

[11] This committee was a precursor of the 24-member Occupational Classification Committee that contributed to the development of the SOC taxonomy. There is a long-standing tradition of interagency collaboration in the development of occupational classification systems in the U.S. (cf., Gladys L. Palmer, *loc cit;* and U.S. Department of Labor, Bureau of Labor Statistics (1992), *Standard Occupational Classification System: Current Status and Recommendations for the Future*, Washington, DC: July 23, 1992, p. 4, which reports that "occupations added to the DOT since 1980 have been assigned SOC codes through a cooperative effort by the Employment and Training Administration (ETA) DOT staff and the Bureau of Labor Statistics' (BLS) Occupational Employment Statistics staff. These assignments have not been added officially to the SOC since no amendments or supplements have been authorized. The assignment of new DOT occupations to SOC codes has become more difficult over time. Often these new occupations involve skills and/or job duties which did not exist when the 1980 SOC was developed."

[12] See: David W. Stevens (1991), *Canada's National Occupational Classification Taxonomy*, Washington, DC: Advisory Panel for the *Dictionary of Occupational Titles*,

Appendix p. 1, which describes this four-level classification of approximately 7,000 occupational descriptions. Canada's aggressive labor market policies of the mid–1960's had increased interest in creating a single multi-purpose classification taxonomy. This lesson should not be ignored as the United States embarks on its own "more aggressive" workforce agenda in the mid–1990's.

[13] The original 1977 SOC taxonomy has been revised once—in 1980. See: U.S. Department of Commerce, Office of Federal Statistical Policy and Standards (1980), *Standard Occupational Classification Manual*, Washington, DC. U.S. Department of Labor, Bureau of Labor Statistics (1992), *op cit*, pp. 8–9, reports that "in response to the introduction of the 1980 SOC, the OES [Occupational Employment Statistics] program undertook an extensive revision of its own occupational classification system, reducing the number of occupations by more than half, from 2,000 to less than 800. The revised OES structure was designed to be compatible with the SOC, but it is not completely based on the SOC classification system. It includes emerging paraprofessional occupations as well as a number of skilled occupations in the health and computer science fields which had not been separately identified in the 1980 SOC. Occupations which have subsequently been added to the OES system have been based on occupations in the DOT."

[14] In some cases, such as SOC major group 24 vocational and educational counselors, or SOC major group 27 veterinarians, there is no further breakout to a minor group or unit group level. Similarly, some SOC minor groups, such as 392 air traffic controllers, or 396 legal technicians, provide no unit group detail. These examples contrast with SOC minor group 434–5 commodities salespersons, which contains 13 unit groups; and with minor group 766–7 machine operators and tenders—assorted materials, which includes 18 unit groups. DOT codes appear at the most detailed SOC level in each case. DOT codes that have appeared since the 1977 fourth edition of the *Dictionary* have been assigned SOC codes (see endnote 11), but no update of the 1980 *Standard Occupational Classification Manual* itself has been published.

[15] The six SOC minor group codes in the health technologists and technicians division are 362 clinical laboratory technologists and technicians, 363 dental hygienists, 364 health record technologists and technicians, 365 radiologic technologists and technicians, 366 licensed practical nurses, and 369 health technologists and technicians not elsewhere classified.

[16] Paul D. Geyer (1992), "Issues of Reliability and Validity in Ratings of Occupational Characteristics in the Dictionary of Occupational Titles: Draft Interim Report," Washington, DC: Advisory Panel for the Dictionary of Occupational Titles, U.S. Employment Service, Employment and Training Administration, U.S. Department of Labor, states, on p. 24, "unclear is whether or not occupational requirements vary in the same ways as do human attributes. For example, should occupations be described with respect to each GOE [Guide for Occupational Exploration] Interest or each GATB [General Aptitude Test Battery] Aptitude? Initiation of a series of confirmatory factor analyses involving subsets of DOT items and scores representing corresponding human attributes would be informative in terms of the commonality of dimensions and the need to describe occupations as precisely as we are capable of describing workers." Also see: Ivar Berg (1970), *Education and Jobs: The Great Training Robbery*, New York, NY: Praeger Publishers, pp. 40–41, where it is observed that "variations in the characteristics of people performing adequately *within* occupational groups have been found to be as great as variations *among* these groups." These expert conclusions are of particular importance in the mid-1990's, when new regulations for the Job Training Partnership Act require completion of a client-specific training plan that identifies a particular occupational opportunity; when the Americans With Disabilities Act requires the identification of reasonable accommodations that will expand occupational opportunities for physically and mentally challenged people; when alien worker certification procedures require a matching of qualifications and requirements in the context of a specific local labor market; and when life-long learning is being promoted as an answer to the Nation's poor productivity record in recent decades.

[17] This total of 663 SOC occupational categories includes the 537 unit groups, plus 116 minor groups that are not broken out into unit groups, and the 10 major groups that do not provide any minor group detail.

[18] DOT occupations are distributed unevenly among the SOC *Manual's* occupational categories. Just one DOT occupation appears in SOC minor group 112 executives and general administrators—*Dictionary* code 188.117–114 City Manager; while SOC minor group 772 assemblers lists 509 DOT codes. The 1990 Census occupational code 785 assemblers illustrates still another level of aggregation, which combines the 509 DOT codes found in SOC minor group 772 with an additional 147 DOT codes that appear in SOC minor group 774 fabricators not elsewhere classified. This means that the descriptive detail of 656 DOT occupations is hidden within a single counting statistic "cell"—the number of assemblers reported in the 1990 Census.

[19] The three DOT occupations listed in SOC unit group 1636 computer engineers are: 003.167–062 systems engineer, electronic data processing; 020.062–010 computer-applications engineer; and 020.067–010 engineering analyst.

[20] The new 3-digit occupational groups that appear in the 1991 *Dictionary's* 03 division are: 030 occupations in systems analysis and programming; 031 occupations in communications and networks; 032 occupations in computer systems user support; 033 occupations in com-

puter systems technical support; and 039 computer-related occupations not elsewhere classified.

[21] The other two alternate titles for DOT code 033.167–010 are information processing engineer and data processing methods analyst.

[22] The requirements and qualifications shown for the 1991 *Dictionary's* occupational category 033.167–010 were last updated in 1988.

[23] See: U.S. Department of Labor, Bureau of Labor Statistics (1992), *Outlook: 1990–2005*, Bulletin 2402, Washington, DC p. 103 for a description of the data sources and procedures that are used in the last of six steps that are followed to project occupational employment by industry in the United States. Briefly, base-year occupational employment estimates reflect information about the occupational distribution of wage and salary employment that is collected by the State Employment Security Agencies through a cooperative agreement with the Bureau of Labor Statistics. This staffing pattern information is collected through surveys that are conducted on a 3-year cycle, covering approximately one-third of the Nation's economy each year. The 1992 *Outlook* volume is based on occupational staffing pattern information that was collected in "1987 surveys of wholesale and retail trade, regulated industries, and State and local governments; 1988 surveys of manufacturing industries and hospitals; [and] 1989 surveys of mining, construction, finance, and services." These surveys cover 775 occupations in 367 industries. The 1992 *Outlook* volume reports that "in developing the base-year matrix, occupations having fewer than 5,000 workers were aggregated into similar larger occupations or appropriate residuals. Also, industries employing less than 50,000 workers were aggregated into residuals within the same 2-digit SIC [Standard Industrial Classification], if their staffing patterns were comparable to the residual. As a result of this aggregation, the 1990–2005 projections cover 507 occupations in 258 industries." Furthermore, since some occupations are entered in a residual category by employers who complete the Occupational Employment Statistics survey instrument, there is a need to extract these and combine them with decennial Census employment data to achieve economy-wide employment estimates. These staffing pattern figures are applied to industry employment estimates from the Bureau of Labor Statistics' Current Employment Statistics establishment survey. The Occupational Employment Statistics surveys do not cover all sectors of the economy. Staffing pattern information for wage and salary employment in agriculture, forestry, fishing, hunting, and trapping, are drawn from the decennial Census of Population. These staffing pattern figures are then combined with base-year employment estimates derived from the Current Population Survey of households, which is conducted by the Census Bureau. Estimates of wage and salary employment in private households, the self-employed, unpaid family workers, and Federal Government employment are also obtained from this household survey. Occupational staffing pattern information for the Federal Government is obtained from the Office of Personnel Management, which is a Federal agency. The occupational classification taxonomy used by the Office of Personnel Management is more detailed than that used by the Bureau of Labor Statistics, so aggregation is required. Aggregation is also required for estimates of self-employment and unpaid family workers, which combine Current Population Survey and decennial Census data. Richard E. Dempsey (1991), *An Appraisal of NOICC/SOICC Needs for Data from the 1990 Decennial Census*, NOICC Occasional Papers/2, Washington, DC: National Occupational Information Coordinating Committee, February 1991, p. 5, describes the use of Census data in earlier occupational projections prepared by the Bureau of Labor Statistics.

[24] Using unpublished BLS data, a 1990 employment estimate of 55,497 computer engineers was derived. The first step in this computation was to determine that 16 percent of total employment in the published occupational category other engineers were computer engineers. The second step was to multiply this 16 percent figure times the published figure of 346,855 for other engineers. At this point, a one-time barrier was encountered because the OES occupational category computer engineer was first introduced in the 1989 survey, which covered only the manufacturing sector, this is known to be an inaccurate estimate of economy-wide wage and salary employment of computer engineers. An additional problem arises, when it is realized that self-employed computer engineers are not represented in this estimate. The Bureau estimates that there were 12,000 self-employed other engineers in 1990, based on CPS data. This total must be allocated among the seven unpublished occupational categories identified in the text of this paper. There is no obvious rule to follow in doing so.

[25] These two occupations share the same General Education Development (GED) scale rating of 5, and a common strength designation of "sedentary."

[26] Many uses of what has been referred to here as *counting statistics* do not require a combining of historical or projected occupational employment figures with the DOT's descriptors of requirements and qualifications. For these uses the current Occupational Employment Statistics program taxonomy might be satisfactory. Examples of such non-transaction uses of occupational information include descriptions of historical trends of occupational employment; analyses of the changing demographics of occupational employment over time; and investigations of interindustry mobility patterns that include information about occupational status at both the points of origin and destination.

[27] Some defenders of the *Dictionary's* relevance argue that some occupations have not changed much in the past 25 years. However, no one would say this about

computer-related occupations. The 1991 *Dictionary* provides descriptions for 21 computer-related occupations, 13 of which were last updated in 1990, and 4 of which were last updated in each of the years 1989 and 1988. Even 3- to 5-year-old information about computer-related occupations is unlikely to be considered "current."

[28] See Richard E. Dempsey's paper prepared for the June 1993 International Occupational Classification Conference, to be convened by the Bureau of Labor Statistics, U.S. Department of Labor, for elaboration of these differences.

[29] Caution must be exercised in embracing the possibilities that electronic updating might offer. While there will be a growing number of occupational information users who would welcome an opportunity to subscribe to an on-line *Dictionary*, there will still be many who will remain dependent upon a print version of the *Dictionary*. This will create a two-tier system of occupational information accuracy.

[30] Occupational information is collected in household and establishment settings. The decennial Census produces both self-reported and proxy respondent occupational information, most in an unassisted completion of a census questionnaire, but sometimes involving a census interviewer. The monthly Current Population Survey program produces self-reported and proxy respondent occupational information in an interviewer assisted context. Occupational information is collected from establishments through the cooperative Bureau of Labor Statistics-State Employment Security Agencies Occupational Employment Statistics program occupational staffing pattern survey. Again, most responses are completed in an unassisted context, but some assistance is provided by State Employment Security Agency personnel, usually in a telephone conversation. See: Wesley Mellow and Hal Sider (1983), "Accuracy of Response in Labor Market Surveys: Evidence and Implications," *Journal of Labor Economics*, 1:4, pp. 331–344, where it is reported on p. 342 that "almost one-half of workers surveyed indicate a different detailed occupation than is reported by their employer." Richard E. Dempsey is currently conducting a research project for the U.S. Department of Labor's Western Area Occupational Analysis Field Center on the topic "Occupational Classification Systems Used to Collect Data From Households and Employers."

[31] See: R. Cotterman and F. Peracchi (1992), "Classification and Aggregation: An Application to Industrial Classification in CPS Data," *Journal of Applied Econometrics*, Vol. 7, pp. 31–51, which notes, on p. 31, that ". . . to facilitate understanding and communication, it is generally necessary to aggregate from the most detailed level, even though this may entail some loss of information. The questions then arise of how to aggregate and when to stop aggregating. That is, how does one aggregate so as to maintain important industry distinctions, and where does the information loss become great enough to dominate the desire for additional parsimony?" An earlier monograph, which used the same statistical technique to investigate occupational classification issues, is Finis Welch and Iva Maclennan (1976), *The Census Occupational Taxonomy: How Much Information Does It Contain?*, R–1849–HEW/DOL (September 1976), Santa Monica, CA: The Rand Corporation, p. v.

[32] The Internal Revenue Service has recently announced a stepped-up enforcement of "independent contractor" rules, which the Service alleges have been abused by employers who seek to escape tax liabilities. Many of these independent contractors are high-skill professionals, and many observers expect rapid growth of employment opportunities of this type. This translates into a need for appropriate projections of the occupational employment of independent contractors.

[33] For example, some observers are skeptical of the ability of household data collection methods to distinguish among systems analysts, computer engineers, and computer scientists.

[34] See: Joop Hartog (1992), *Capabilities, Allocation and Earnings*, Boston, MA: Kluwer Academic Publishers, which provides theoretical and empirical contributions based on a recognition that ". . . the labor market should be decomposed at two sides, with supplied services distinguished according to a number of capabilities of individuals and demand according to the differential use that can be made of such services, measured by job requirements and level of job complexity" (p. 288); Alfred J. Field and Arthur H. Goldsmith, "The Impact of Formal On-The-Job Training on Unemployment and the Influence of Gender, Race, and Working Lifecycle Position on Accessibility to On-The-Job Training," in William Darity, Jr. (ed.) (1993), *Labor Economics: Problems in Analyzing Labor Markets*, Boston, MA: Kluwer Academic Publishers, which concludes that "it seems clear that people of the same age, experience, and tenure may possess significantly different skill levels as a result of differential formal on-the-job training activities. Unfortunately, no effort is made to account for this source of worker heterogeneity in current empirical work. Thus the existing research which attempts to measure both informal and formal on-the-job training with one variable (for example, age, experience, tenure) is statistically flawed" (p. 79); and Lawrence Mishel "Comment: Skill Requirements and the Workforce," (which comments on Arnold H. Packer and John G. Wirt, "Changing Skills in the U.S. Work Force: Trends of Supply and Demand"), both in George E. Peterson and Wayne Vroman (1992), *Urban Labor Markets and Job Opportunity*, Washington, DC: The Urban Institute Press, who concludes that ". . . there is little evidence that there has been a rapid increase in overall skill requirements in the job structure as a whole. There is also no credible evidence of a future explosion of skill requirements. . . . A careful analysis of Bureau of Labor Statistics (BLS) employment projec-

tions also shows that changes in the job structure will not dramatically change skill and education requirements" (p. 72). Each of these studies highlights the barriers that are encountered in attempting to combine information about job requirements, employee qualifications, and historical/projected employment opportunities.

[35] Canada's National Occupational Classification (NOC) taxonomy uses an *actual mobility* criterion for grouping, with observed movement within an occupational grouping being greater than that observed between cells. Furthermore, movement between adjacent cells is more frequent than movement between cells that do not share a common boundary (in a matrix format). Australia's Standard Classification of Occupations (ASCO) is conceptually based on a *potential mobility* criterion for grouping, but exceptions to this principle have been revealed—see Brian L. Embury (1991), "The Use and Gathering of Occupational Information in Australia," (no organizational identification), which reports, on p. 22, that "the [Australian] design objective was to group occupations in such a way that any given individual would have the potential to move between occupations in the same unit group without the need for significant retraining but he or she would not have the potential to move between occupations in different unit groups without some additional training; the greater the move required, the greater the additional training necessary. Hence, one can interpret the classification as a model of potential transferability of human resource skills in the Australian economy. The qualifying word *potential* is significant. ASCO attempts to model the potential mobility of labour between occupations according to the task similarity of those occupations. It is not based on observed patterns of labour mobility in the current labour market. Hence, the model lacks empirical validation based on observed behaviour but, at the same time, it is not constrained by the institutional barriers to mobility present in any labour market. The deliberate choice of potential transferability rather than observed transferability as the focus of the model was made on the basis of the intended applications of the classification. The greatest need for statistics based on ASCO will be during times of significant structural change in the economy as a result of events such as major changes in government policy, the outbreak of war, or the collapse of our external markets. At such times, many existing institutional constraints to labour market mobility are likely to be swept away. A model which is limited by such constraints will soon become irrelevant and hence useless as a planning tool." Also see: Joe Maxwell (1992), "Review of Report on Classification and Occupational Information Systems in the Netherlands," (no organizational identification), where it is reported, on p. 8, that "The basic classification principle [in the Netherlands Central Bureau of Statistics' 1992 Occupational Classification] is transferability of skills; this is potential transferability, rather than actual mobility among occupations." For germane theoretical treatments of this topic see: Kenneth I. Spenner (1990), "The Measurement of Skill: Strategies and Dilemmas with Special Reference to the Dictionary of Occupational Titles," Durham, NC: Department of Sociology, Duke University; Bruce McKinlay (1976), *Characteristics of Jobs That Are Considered Common: Review of Literature and Research,* Information Series No. 102 Columbus, OH: The Center for Vocational Education, p. 40, which quotes Haller and Portes (1973), "Status Attainment Processes," *Sociology of Education,* Winter 1973, p. 52, where it is observed that "for the most part there is a paucity of causal explanations of mobility at the individual level. The magnetism exercised on researchers by the mobility problem has meant almost exclusive concentration on description—analysis of conventional mobility matrices per se—to the neglect of explanation—study of the possible determinants of observed status movements." Dixie Sommers (1979), *Empirical Evidence on Occupational Mobility,* Information Series No. 193, Columbus, OH: The National Center for Research in Vocational Education, The Ohio State University; James G. Scoville (1972), *Manpower and Occupational Analysis: Concepts and Measurement,* Lexington, MA: D.C. Heath and Company; Joyce R. Shackett and David W. Stevens (1981), "Elasticity of Substitution Across Occupations, Occupational Coding, and Accountability in Vocational Education," in National Commission for Employment Policy, *The Federal Role in Vocational Education: Sponsored Research,* Special Report No. 39, Washington, DC, pp. 215–244; and Jack E. Triplett (1990), "The Theory of Industrial and Occupational Classifications and Related Phenomena," in Bureau of the Census, *1990 Annual Research Conference: Proceedings,* Washington, DC: U.S. Department of Commerce, pp. 9–25.

[36] Bureau of Labor Statistics (1992), *op cit,* p. 5.

[37] The National Occupational Information Coordinating Committee has prepared a tabulation of these characteristics differences. It is important to understand that the differences that appear in the *Dictionary's* occupational descriptions are an artifact of the sampling protocols that were used by the Occupational Analysis Field Centers to select sites for conducting job analyses. The representativeness of the recorded characteristics is constrained by this sampling regimen.

[38] The six unit-group SOC occupational categories are: 7332 welding machine setup operators; 7532 welding machine operators and tenders; 7714 welders and cutters; 7333 soldering and brazing machine setup operators; 7533 soldering and brazing machine operators and tenders; and 7717 solderers and brazers.

[39] The 1990 Census classification of occupations groups the SOC's three 4-digit unit groups of welders and cutters (machine setup operators, machine operators and tenders, and welders/cutters themselves) into one Census code—783 welders and cutters. Similarly, the 1990 Census clas-

sification groups the SOC's three 4-digit solderer and brazer unit groups into one Census code—784 solderers and brazers. The Bureau of Labor Statistics' Occupational Employment Statistics program collects survey information for four related occupational categories—soldering and brazing machine operators and tenders; soldering and brazing machine setters and set-up operators; welding machine operators and tenders; and welding machine setters and set-up operators. However, the respective operator/tender and setter/set-up operator categories are aggregated before occupational projections are released. The counterparts of the SOC's other relevant unit groups, solderers/brazers and welders/cutters, are not identified separately in the OES program's survey; and they are grouped with 12 other occupations in published projection estimates for hand workers including assemblers and fabricators.

[40] See: Paul D. Geyer (1992), *loc cit;* and Ann R. Miller, Donald J. Treiman, Pamela S. Cain and Patricia A. Roos (eds.) (1980), *Work, Jobs, and Occupations: A Critical Review of the Dictionary of Occupational Titles,* Washington, DC: National Academy Press, for comprehensive examinations of the DOT's classification components.

[41] See: 1991 Revised Fourth Edition, *Dictionary of Occupational Titles,* Volume II, appendix C: "Components of the Definitional Trailer," p. 1009. This appendix continues that "This training may be acquired in a school, work, military, institutional, or vocational environment. Specific vocational training includes: vocational education, apprenticeship training, in-plant training, on-the-job training, and essential experience in other jobs." Australia's Standard Classification of Occupations disaggregates this composite into separate academic preparation, vocational/apprentice preparation, and on-the-job preparation components. Consider how useful this disaggregation would be if the United States adopts the major changes in its vocational education, apprentice and work-based learning investments that have been proposed by the new Administration. Also consider how the provisions of the Americans with Disabilities Act of 1990 create unique occupational classification needs in the United States with respect to the concepts of "typical worker" and "average performance."

[42] See: Stephen J. Barley (1991), *The New Crafts: The Rise of the Technical Labor Force and Its Implications for the Organization of Work,* Philadelphia, PA: The National Center on the Educational Quality of the Workforce, University of Pennsylvania; Sue E. Berryman and Thomas R. Bailey (1992), *The Double Helix of Education and the Economy,* New York, NY: The Institute on Education and the Economy, Teachers College, Columbia University; Commission on the Skills of the American Workforce (1990), *America's Choice: High Skills or Low Wages!,* Rochester, NY: National Center for Education and the Economy; Secretary's Commission on Achieving Necessary Skills (1991), *What Work Requires of Schools,* Washington, DC: U.S. Department of Labor; National Advisory Commission on Work-Based Learning (1992), *Framework for Action,* Washington, DC: U.S. Department of Labor; and Peter Cappelli (1992), "Is the 'Skills Gap' Really About Attitudes?" *EQW Working Papers,* Philadelphia, PA: The National Center on the Educational Quality of the Workforce, University of Pennsylvania. Jobs have been redefined to encompass more tasks and to permit more autonomy and discretionary action. The latent capacity to act in a responsible manner when necessary is therefore a highly valued candidate qualification. One implication of this for occupational classification is that the concept of the "nature of the work performed" has to be expanded to represent the "nature of the work *that might* be performed." This, in turn, means that it is more difficult to document hypothetical performance requirements that are unlikely to be observed in a site-visit job analysis context.

[43] See *The Wall Street Journal,* March 10, 11 and 16, 1993, page A1 in each case, for articles in a series titled "Down the Up Escalator: Why Some Workers are Falling Behind." The titles of these three articles are compelling, "Age of Angst: Workplace Revolution Boosts Productivity at Cost of Job Security; Globalization, Automation and Shrinking Industries Spread the Fear of Firing; The Fading Era of Big Daddy;" "Hired Out: Workers are Forced to Take More Jobs with Few Benefits; Firms Use Contract Labor and Temps to Cut Costs and Increase Flexibility; Critics: Savings are Illusory;" and "Price of Progress: 'Re-Engineering' Gives Firms New Efficiency, Workers the Pink Slip; One Company After Another Redesigns Tasks to Curb its Need for Employment; But Long View is Reassuring."

[44] Stephen J. Barley (1991), *loc cit.* See: J.E.S. Lawrence (1990), *Occupational Information and International Development: Improving HRD Diagnostics,* Occasional Paper No. 1, Washington, DC: National Occupational Information Coordinating Committee (December 1990), for a related investigation of this topic from an international perspective.

[45] The 1980 *Standard Occupational Classification Manual's* stated principle is that supervisors are to be identified separately from the workers they supervise. The "Master Titles and Definitions" section of the *Manual* states, on p. 14, that "supervisors (or foremen) are classified according to the occupations of the workers they supervise. A supervising worker who primarily performs duties such as those supervised, and who may be commonly known as a group leader or leadman, is classified in the same unit group as the workers." If the documentation of actual mobility paths is chosen as an important classification criterion, then collection of updated information about changes in the organization of work

that have occurred since 1977 should be given a high priority.

[46] See: 1991 Revised Fourth Edition *Dictionary of Occupational Titles,* Volume II, appendix C: Components of the Definition Trailer, III "General Educational Development," pp. 1009–1012.

[47] Other components of the *Dictionary's* Definition Trailer are Physical Demands-Strength Rating and Guide for Occupational Exploration (GOE).

[48] This difference in number of GED scale levels is that "the diversity of language courses offered at the college level precludes the establishment of distinct levels of language progression for these four years. Consequently, language development is limited to five defined levels of GED inasmuch as levels 5 and 6 share a common definition, even though they are distinct levels." See: 1991 *Dictionary,* Volume II, Appendix C, p. 1012.

[49] 1991 *Dictionary of Occupational Titles,* Volume II, appendix C, p. 1012.

[50] Reduction of this variance of SVP values within SOC categories will not be an action item if the components of the SVP itself are updated and reported separately. Today, no distinction is made between, say, 2 years of community college combined with 2 years of relevant work experience, 4 years of college, and 4 years of pertinent employment, as qualifying preparation. There is no problem here, if, and only if, it really doesn't matter which route to qualification is taken. In most cases, the payoff to traveling different paths would be expected to matter.

[51] Compatibility is not synonymous with conformity. Conformity requires accordance with a specified standard. Compatibility is less demanding—requiring only a capability to exist together in harmony. Advocates of a coordinated revision of the 1991 *Dictionary of Occupational Titles* and 1980 *Standard Occupational Classification Manual* are positioned along a conformity-compatibility continuum, which stretches from those who advocate full consolidation of the DOT and SOC classifications into a single all-purpose taxonomy, to those who endorse coexistence without substantial elimination of the *Dictionary's* descriptive detail.

[52] See: Peter B. Doeringer (ed.)(1991), *Turbulence in the American Workplace,* New York, NY: Oxford University Press.

[53] Other examples were developed in the research that was conducted in support of this paper. These are available from the author upon request.

[54] Brian L. Embury (1991), *op cit,* pp. 20–21.

[55] See: Michigan Occupational Analysis Field Center (1992), *Standard Occupational Classification: Principles of Classification,* Detroit, MI, September 2, 1992, p.4. Also see: Michigan Occupational Analysis Field Center (1992), *Classification Issues and Options,* Detroit, MI, June 8, 1992.

[56] *Business Week* magazine's February 8, 1993 cover story, pp. 99–103 is titled "The Virtual Corporation". The theme of this article is that the traditional short-term strategic alliance among multiple partners in the movie-making and construction industries is expected by some observers to quickly spread throughout the economy. The vision is that "teams of people in different companies would routinely work together, concurrently rather than sequentially, via computer networks in real time." The transitory nature of the alliances that are foreseen would make the designation of industrial affiliation of employment much more difficultunless the business services sector is expanded and refined to accomodate this type of change. "Here today, gone tomorrow" is not the industrial classification specialist's favorite discovery!

[57] See: 1991 Revised Fourth Edition *Dictionary of Occupational Titles,* Volume II, "Industry Index", pp. 1023–1025. This *Dictionary,* Volume I, pp. xx-xxi describes the use of this industry designation. "It often differentiates between two or more occupations with identical titles and different duties. Because of this, it is an integral and inseparable part of any occupational title. While a definition usually receives the designation of the industry or industries in which it occurs, certain occupations occur in a large number of industries. When this happens, the industry assigned is a cross-industry designation. For example, clerical occupations are found in almost every industry. To show the broad, cross-industry nature of clerical occupations, 'clerical' is an industry designation in itself. Among other cross-industry designations are: 'profess. and kin.', 'machine shop,' and 'woodworking.' Occupations which characteristically occur in nearly all industries, or which occur in a number of industries, but not inmost industries and which are not considered to have any particular industrial attachment, are assigned the designation of 'any industry.' In compiling information for the DOT, analysts were not able to study each occupation in all industries where it occurs. The industry designation, therefore, shows in what industries the occupation was studied but does not mean that it may not be found in others. Therefore, industry designations are to be regarded as indicative of industrial location, but not necessarily restrictive." Several occupational classification experts, who reviewed an early draft of this paper, criticized the actual historical basis for the DOT's current industry designations, and urge a serious review and revision of this occupational descriptor.

[58] See: Pamela Frugoli (1992), "Some Observations on the DOT as it Relates to Employment and to Required Training Time: Implications for the DOT Review," Washington, DC: National Occupational Information Coordinating Committee, p. 7.

[59] Time-series consistency is a major issue here. Revision of the Nation's occupational classification taxonomies will require revision of affected time-series

data sources. Both government and proprietary opportunities to provide value-added services of this type will arise.

[60] See, for example, Wade Lambert (1993), "No Bias Seen in Homogeneous Work Force," *The Wall Street Journal*, March 11, 1993, p. B5, which reports Judge Richard Posner's statement that "It is not discrimination, and it is certainly not active discrimination, for an employer to sit back and wait for people willing to work for low wages to apply to him, ... The fact that they are ethnically or racially uniform does not impose upon him a duty to spend money advertising in the help-wanted columns of the Chicago Tribune." This is cited here because it indicates a value-added opportunity to provide better information about occupational employment opportunities to job seekers.

[61] Many of these beneficiaries of higher quality occupational information will be able to "capture" some part of the higher value-added for themselves. This raises questions about how the costs of providing the occupational information enhancements ought to be allocated, and how the benefits should be allowed to accrue. Brief observations about these topics are made later in this paper, but each of these topics warrants further investigation.

[62] See: Robert G. Sheets (1992), "National Skill Standards and Certification," DeKalb, IL: Center for Governmental Studies, Northern Illinois University.

[63] Better information is also needed about projected changes in "institutional constraints" (for example, the dynamics of work-based learning, the growth of independent training vendors and private career schools, the evolution of community college curriculums, and new forms of employee-employer cooperation). See, for example, Sue E. Berryman and Thomas R. Bailey (1992), *loc cit.* Also see: Robert C. Dauffenbach, Jr. (1974), *The Structure of Occupational Mobility in the U.S. Economy*, Ann Arbor, MI: University Microfilms, p. 106, where the author elaborates upon the economist's distinctions among (1) an *ability* to move between occupations; (2) a *willingness* to move; and (3) an *opportunity* to move, which he explores in the context of Glen G. Cain, W. Lee Hansen and Burton A. Weisbrod's often-cited paper "Classification of Occupations: Some Problems of Economic Interpretation," in American Statistical Association (1966), *Proceedings of the Social Statistics Section*, Washington, DC, pp. 199–203. The *ability* to move is consistent with what most non-economists focus on in grouping occupations—the extent to which competencies required in one occupation qualify an individual to move to another occupation. This sets an upper limit on the amount of potential mobility. The *willingness* of incumbents to move acts as a constraint, or ceiling, below this upper limit—not everyone who is able (for example, qualified) to move is willing to change occupations. The *opportunity* to move imposes a still lower ceiling on actual mobility—some who are both able and willing to change occupations do not have the opportunity to do so. These distinctions will be more important than ever as the Administration's new initiatives get underway.

[64] See: John H. Bishop (1993), *Educational Reform and Technical Education?*, Working Paper 93–04, Ithaca, NY: Center for Advanced Human Resource Studies, New York State School of Industrial and Labor Relations, Cornell University, January 3, 1993, p. 49; (1993), *Overeducation*, Working Paper No. 93–06, Ithaca, NY: Center for Advanced Human Resource Studies, New York State School of Industrial and Labor Relations, Cornell University, January 12, 1993, p. 17; and The National Center on the Educational Quality of the Workforce (1992), *A Crosswalk of National Data Sets Focusing on Worker Training*, Philadelphia, PA: University of Pennsylvania.

[65] See: Karl F. Botterbusch (1992), *op cit*, pp. 18–19.

[66] The availability of a new occupational classification taxonomy would not *automatically* translate into an immediate adoption of this revision for alien labor certification purposes. Some of the State Employment Security Agencies currently register job-seeking applicants using the 1977 Fourth Edition DOT, while accepting job orders from employers using the 1991 Revised Fourth Edition DOT.

[67] Here, employment opportunity does not mean awareness of a job vacancy. Instead, it refers to the frequency of appearance of a particular occupational response in completed data collection instruments.

[68] This is the topic of Richard E. Dempsey's paper.

[69] The cost of accurately recording occupational employment counts would not be expected to be constant across occupations, which means that the number of occupations that can be covered with a fixed budget is affected by which occupations are to be covered. Given a budget allocation, the number of occupations covered can be increased by concentrating on occupational categories in which incumbents can be counted at relatively low cost.

[70] In the approach that is being discussed here data collection instruments and instructions might accurately record changes in the job requirements and candidate qualifications of, say, secretaries; but analysts would not automatically know about these changes. Explicit provision for such awareness would have to developed.

[71] This appears to provide an attractive opportunity for the Federal Government to negotiate with vendors and other interested parties who might be expected to bear some, or all, of the costs associated with continued collection of job requirement and candidate qualification descriptors for these occupation categories, which might be terminated otherwise. In other words, the future pegboard of occupations in the United States might be compartmentalized into three segments—a "must have" segment of consolidated occupational categories; a "might

want to retain" segment of occupational categories that provide either counts or descriptors, but not both; and a "consider for termination" segment of count only and descriptor only occupational categories. The boundary between the last two segments is intentionally "soft," to convey the different dialogues that would be expected to ensue between the Federal Government, vendors and users of occupational information. The burden of proof in the "might want to retain" case would be on the Federal Government to describe why private parties should be expected to absorb some, or all, of the costs of data collection. This contrasts with the "consider for termination" case, where the burden of proof would be on the private parties to make the case for retention under any circumstances, whether there is cost-sharing or not.

An Occupational Classification System for Collecting Employment Data from Both Households and Employers

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Introduction

A historian has noted that the "true history of a Nation can never be known unless we know about the work and lives of the laboring population—for they are the broad base on which all material achievement rests".[1]

Since the early 1900's, the U.S. Department of Labor has been examining and aiding that "laboring population." As America enters the last decade of the century, the Department of Labor has formed a Workforce Quality Agenda to insure that American workers have the skills needed to meet the demands of the 1990's and beyond. Agreeing with his predecessors, the newly-appointed Secretary of Labor has written that "All Americans used to be roughly in the same economic boat. We are now in different boats, one sinking rapidly, one sinking more slowly, and the third rising steadily."[2]

One of three panels comprising the Workforce Quality Agenda, the Advisory Panel on the Dictionary of Occupational Titles (APDOT) is reviewing the *Dictionary of Occupational Titles* (DOT). Does this extensive document of almost 13,000 job descriptions and 30,000 job titles contain useful information about the workers in the three boats, for those who employ them, and for those who train them? How could the *Dictionary* be improved to meet "the diverse needs of the occupation information community?"[3]

This examination is part of a continuing Department of Labor process that includes a critical study of the DOT by a private contractor in 1979, another study questioning the reliability and validity of the DOT in 1980, and the publication of a dozen questions in the *Federal Register* in August, 1990. Almost four dozen State and local government agencies responded to those questions, along with a dozen associations and another dozen educational institutions. Other respondents brought the total to 90.

Partially in response to the concerns expressed, the APDOT decided to examine ways to develop a system of classification that is technically and conceptually compatible in meeting the needs of multiple users. To do so, it is necessary to examine classification systems other than the DOT, especially the Standard Occupational Classification (SOC), the Census/Current Population Survey (CPS), and the Occupation Employment Statistics (OES) survey.

While being well aware that "no country has been able to devise one system for all purposes,"[4] APDOT has contracted a series of papers that will be presented at an international conference in June, 1993. This document is one of those papers. It addresses a central core question: How can a new SOC be used to collect data from both employers and households? The response to that question may provide help in the process of determining the content and organization of the new *Dictionary of Occupational Titles.*

This paper begins with an executive summary and includes four major sections. The first section discusses the background of how different data collection systems came into being, how they fulfill complimentary purposes, and how their strengths and weaknesses arise from the conceptual framework of each.

The next section describes the process CPS and OES use to collect and classify data and how that data serves diverse users. After summarizing the hurdles in each part of the procedures, it defines the problem: how can a new SOC be best designed to provide a classification system to collect data from households and employers?

Section three demonstrates that the current systems are very compatible by offering crosswalks that compare current SOC occupations to those listed in the OES and CPS.

The final section draws conclusions and makes recommendations based on an analysis of the study findings.

Executive summary

For more then a century, the Federal Government has been collecting information on the make-up of the Nation's occupational workforce as part of the decennial census. Over five decades ago, similar information began to be collected as a regular part of the household-based Current Population Survey (CPS) program. Both systems have limitations. For example, the census is conducted at 10-year intervals and becomes quickly dated. The CPS has a relatively small sample that can only support limited national employment estimates. Both the census and the CPS use the same occupational classification system. They both also provide a wealth of information about the characteristics of workers, such as age, sex, race, etc. However, the time and geographic limitations of these programs resulted in the creation of the Occupational Employment Statistics (OES) program at the Bu-

reau of Labor Statistics (BLS). The OES program collects occupational employment data directly from a sample of employers using a mail questionnaire. Employment estimates from the OES are available at the State level and cover the economy on a three year cycle. As presently designed, the OES program provides employment estimates by 3-digit Standard Industrial Classification (SIC) industry but does not provide information on the characteristics of the workers. Because two different systems were designed to collect information from different sources (households versus employers) using different collection processes (personal visit versus mail questionnaire) differing occupational classification systems resulted. Some critics complain that one, or the other, of the two classification systems is unnecessary.

Thus, both surveys contain particular advantages and disadvantages. But despite the differences, each collects vital and essential information and both are necessary and of great importance to user groups.

It is crucial not to forget the primary purpose of each: to provide timely and accurate data to large groups of diverse users. One major group needs data to identify trends, make projections, and plan programs. The OES provides these important data. Another group wants the information for use in important national policy areas where the characteristics of the occupational workforce are needed. The census/CPS is often the only source of these essential data.

Since the late 1970's, the Standard Occupational Classification has helped groups of users meet their information needs by bridging the data collected from both households and employers.

By examining the origin of each collection system, it is possible to understand how particular methods of classification evolved. By comparing the status of classification systems of fifteen years ago with those of today, it is evident that great progress has been made toward compatibility. By cross-walking the two systems with the Standard Occupational Classification, it is easy to see that the problem is not as great as many perceive it to be.

Since 1970, the Census Bureau has increased the number of occupations to nudge closer to the number in the SOC. In 98 percent of all cases, Census occupations match SOC occupations. In 3 out of 4 situations, the matches are direct; that is, the user can compare the Census information to the SOC information as it is printed.

At the same time, the OES has also drawn closer to the SOC. In 1992, 39 percent of all occupations between the two classification systems matched directly. In another 46 percent of situations, users could sum multiple OES entries to match a single SOC entry.

Cross-walking occupation coverage of both census and OES to the SOC demonstrates that most direct matches occur in the occupational groups of professional, technical, mechanics, construction trades, and precision production workers. This finding indicates that vocational counselors, education program planners, and others have available to them a basic employment data base. This information is accurate and detailed enough for their needs.

Examining the history of the four classification systems, interviewing those responsible for developing and administering the systems, conducting five separate crosswalks at the National Crosswalk Service Center in Iowa, visiting the Census Bureau Processing Center in Indiana, and analyzing all those findings have led to several conclusions and recommendations.

The SOC accomplishes its original purpose of bringing extant classification systems together. Today, the SOC provides the classification structure for the systems currently used to collect data from both households and employers.

The census/CPS and the OES classification systems will always differ. These differences reflect the built-in constraints of their respective collection processes.

The SOC needs revision, not reconstruction. In this revision, both the census/CPS and the OES are necessary elements. Their compatibility, already in place, offers the SOC a solid starting point.

The National Occupational Information Coordinating Committee serves as an important bridge between developers and users of occupational information. NOICC adopted the SOC as its basis for the occupational information system (OIS); then encouraged implementation of the SOC into career information delivery (CIDS) systems.

Two major recommendations concern revising the SOC Manual and establishing an on-going system. First, the new SOC manual should: (1) be guided by a strong policy agency, such as OMB; (2) represent the current occupational structure of the economy; (3) adopt more complete written definitions such as those used by the OES; (4) include useful cross references (for example, definitions can be cross-referenced to the current census and the current OES title/code).

Next, revising the Manual should be the first project in a continuing series of revision activities. A total revision of the SOC should occur before the next decennial census. As the work force continues to change rapidly, supplements to the SOC should be printed regularly, perhaps every 3 years at the end of the OES cycle. There should also be a central repository for occupational classification information that could provide a base for research. Confidentiality issues are not a major obstacle to establishing such a center.

Finally, one agency should take responsibility for maintaining such a center and preparing supplements. This agency should already have the technical resources and experience in place. The BLS meets these criteria.

Background

Before occupational data are collected, there must be a conceptual framework with two major supports: type of analysis and purpose of the effort.

An important consideration in determining any occupational classification system is the type of analyses planned with the data and/or information collected. For example, job placement requires an occupational classification system that allows for classifying a variety of very detailed job requirements with the characteristics of an individual. However, in the collection of detailed wage data the emphasis is placed on precise and narrowly defined occupations based on skill levels. The purpose of data collection also influences how the data are collected and what classification system is used. For example, if the data are to be primarily used to identify demographic and sociological characteristics of individuals employed in the occupation, the best source of the information is the worker. Thus, if the information is to be collected from the individual worker, the questions must be simple and based primarily on job title. If the purpose is to collect employment information from employers, the classification system must be more precise and based on written definitions.

Another purpose of an occupational classification system is to summarize the thousands of diverse jobs in the economy first into meaningful categories called occupations and, in turn, to group these occupations into broader categories to facilitate meaningful analysis. Of course, grouping occupations may involve the loss of some information. Because the process and conditions of work vary from one detailed occupation to another, and from the same occupation from one industry to another, a combination of occupations can result in average and artificial traits not characteristic of any single component part. Notwithstanding this fact, combinations of specific occupations into larger groupings are generally necessary because of a specific data collection process such as securing an accurate response while at the same time being concerned with space and cost limitations.

The Federal Government currently uses four different major systems of occupational classification. *The Dictionary of Occupational Titles* functions as the common denominator between and among other systems. The Census Bureau conducts household surveys and interviews workers (Current Population Survey, CPS). The Bureau of Labor Statistics surveys business establishments (Occupational Employment Survey, OES). The Office of Management and Budget oversees statistical activities and establishes government wide standards (Standard Occupational Classification, SOC).

In addition, two different systems classify the Federal civilian workforce and military personnel. Each system began with different purposes, examines different issues, and is most useful to different users with different agendas. Meanwhile, major changes in the workplace and in skills development establish the need for a system of occupational collection and classification that is technically and conceptually compatible.

Dictionary of Occupational Titles

During the Great Depression, Congress passed the Wagner-Peyser Act which established a Federal-State employment service system.[5] But this system had no means to match job orders from employers with the skills of individual job seekers. *The Dictionary of Occupational Titles* was created to facilitate that matching.

By defining a job as "a group of tasks performed by an individual"[6] and by observing workers in almost all industries, the DOT researchers wrote detailed definitions for thousands of job titles. The first edition appeared in 1930, the latest, in 1991. The total list of 30,000 job titles, including detailed descriptions of about 13,000 offers "the best snapshot of how jobs continue to be performed in the majority of industries across the country."[7]

DOT provides a common language that allows crosswalks between classification systems and it offers the definitive reference for details on different occupations. But the DOT is far too detailed for employment collection activities.

Census/Current Population Survey

The U.S. Constitution demands a survey of the general population every 10 years to determine the number of representatives each State may send to Congress. From the first census in 1790 until the Great Depression, "no direct measures were made of the number of jobless persons. Mass unemployment in the 1930's increased the need for statistics."[8] Data from the census were only available every 10 years, so the CPS was established to collect current statistics by visiting households and asking individuals about their activity during a designated time period: Were they at work? looking for work? otherwise engaged?

The census is a unique source of occupational employment information at the national, State, and local levels. Until recent years, it was the largest and single most important source of comprehensive data on employment by occupation and today remains the primary source of local data and information on the characteristics of workers.

The census is conducted every 10 years by the Bureau of the Census. All U.S. households are contacted and asked a small number of questions about the status and characteristics of members of household. A sample of the households are asked to complete a longer questionnaire with additional questions concerning their labor force status, such as their occupation and industry of employment. These questions are straightforward; a simple inquiry asking the respondent to identify the job title of each family member and a second question asking for a brief description of the duties of the job. Examples

of job titles and duties are provided. These responses are then classified and coded by the Census Bureau staff using their Classified Index of Occupations and Industries.[9]

Because the respondent is a person, a wealth of information concerning that individual (that is, race, age, sex, income) is collected. Much of the data collected are published and much more are made available in other forms such as data tapes or film.

The CPS is another collection system that uses the census classification. The CPS is a monthly survey of households conducted by the Census Bureau. These data are analyzed and published by the Bureau of Labor Statistics. The CPS survey collects much of the same occupational information as the census and follows the same process in classifying and coding the responses. However, the CPS is only a small, carefully selected sample of about 60,000 households. While the questions concerning employment are similar to the census, the small size of this sample severely limits the amount of data available. Few data are published at the State or local levels.

The CPS sample is carefully designed and structured to provide a limited number of current (monthly) national economic indicators such as the number of persons in the labor force, the numbers of persons employed and unemployed and selected characteristics (age, race, etc.), and other "statistics on labor force status of the civilian, non-institutionalized population, 16 years of age and over."[10]

Trained interviewers contact households and carefully record the responses from a household member. The questionnaires are then transmitted to the Census Bureau Processing Center in Jeffersonville, Indiana where the occupation and industry responses are classified and coded using the Census Bureau's Alphabetical Index of Industries and Occupations. Since 1959, the Bureau of Labor Statistics (BLS) has been responsible for analyzing and publishing those findings.

CPS strengths include:

- Historical continuity—monthly surveys for 50 years offer bases of comparison;
- Characteristics—detailed information about adults;
- Personal contact between householder and interviewer—opportunity to explain the meaning of questions, etc.

As indicated above, the CPS sample is too small to provide monthly data for specific occupations. Each year, the BLS publishes national averages of the number of workers employed, by occupation, together with selected characteristics. But this information is not cross-referenced by geographic area.

Occupational Employment Survey

Employers want to know how their establishment compares to the industry as a whole. Vocational advisers want to know in which direction to guide job seekers. Administrators want data to plan education and training programs. Elected officials need information to base policy on. All need the data at various levels of geographic detail.

More than 20 years ago, these needs were first addressed by the Occupational Employment Survey, a cooperative effort between the Bureau of Labor Statistics and the State Employment Security Agencies (SESA's). The survey covers wage and salary employment in all nonagriculture establishments. Excluded from coverage are the self-employed, agriculture, and private households. The OES collects occupational employment data using a mail questionnaire directly from a large sample of employers. National and State employment estimates are prepared for each 3-digit listing in the Standard Industrial Classification (SIC).

BLS designs the survey and provides procedural guidelines and technical support to cooperating State employment agencies. The State agencies carry out the actual collection and processing of the survey. Over a 3-year cycle, the entire economy is covered.

The OES classification "system was designed to be compatible with the Standard Occupational Classification (SOC)" and definitions were drawn from the DOT.[11] Occupations are selected and written definitions prepared for each industry or group of industry sectors. Early research and testing conducted by the Bureau of Labor Statistics established that a full written occupation definition was essential to collect accurate employment data from employers.[12]

Today, the OES provides users with accurate, current and projected employment estimates for over 700 occupations at the national and State levels. This data base is widely used by administrators and planners of occupational education and job training programs and by individuals making career choices.

The OES collects only employment in an occupation and covers only wage and salaried workers in the nonagriculture sectors of the economy. It does not provide information on the characteristics of these workers. (Currently the collection of wage data is being pilot tested in a number of States.)

Other BLS occupational programs

Another BLS program also makes important contributions to occupational classification issues, namely, the Division of Occupational Outlook. This office has the responsibility of analyzing the data collected in the OES program and preparing projections of employment demand by occupation. One of the major publications is the *Occupational Outlook Handbook*. Individual staff members focus on specific occupational areas, such as medical occupations. They become experts in these fields and are a major source of intelligence on changing and new emerging occupations.

Standard Occupational Classification

Because the DOT, the CPS and the OES originated independently at different times and evolved to serve different users, there was no easy way to compare data among them. In the late 1970's, the Commerce Department, with the support of the Office of Management and Budget and the active participation of most Federal agencies, created the *Standard Occupational Classification Manual* (SOC).

The purpose of the SOC was to "provide a mechanism for cross-referencing and aggregating occupation-related data collected by social and economic statistical reporting programs." [13]

The long-term objective was to draw the three existing systems more closely together and then evolve into the single classification system for occupations. Just as the Standard Industrial Classification (SIC) became accepted as the sole industry classification system, SOC could become the sole system for classifying occupations. However, the SOC *Manual* states "the system is designed for use in statistical analysis and presentation of data about occupations. It was not developed for any programmatic use." [14] Thus, it seems clear that the original intent of the SOC was not universal implementation as the sole system for collecting occupational employment data.

The SOC has proven to be a very useful tool. It provides a widely approved list of occupations organized in a useful hierarchical structure. However, the written definitions are often short and inadequate for data collection purposes. The SOC descriptions depend heavily on the use of assigned DOT codes and titles. To fully understand an SOC occupation, a user has to refer to the DOT. Often a multitude of DOT occupations are assigned to a single SOC occupation with no measure of their relative importance. Most SOC users will not take the time to look up and evaluate several dozen DOT occupations. Most users are seeking a full, self-contained definition and find the written OES job descriptions superior to those presented in the SOC.

The National Occupational Information Coordinating Committee

Another series of developments added more attention to the need to standardize occupational classifications. During the past 30 years, much of the vocational education and employment and training legislation specified that information on the skill needs of the labor market, that is, data on occupational employment demand and supply, be used in planning program offerings. To support the development and use of such data, Congress in 1976 created the National and State Occupational Information Coordinating Committees (NOICC/SOICC). NOICC's statutory membership now consists of nine agencies representing four Cabinet departments concerned with the development and use of occupational data. SOICCs consist of counterpart agencies on the State level.

The NOICC/SOICC mission is to develop an occupational information system (OIS) that includes demand and supply data, based on standard definitions and classifications. To develop this OIS, it adopted the existing programs of its member agencies and the SOC.[15]

Compiling employment demand data and relating it to supply (that is, outputs from education and training programs) required NOICC to interface many diverse occupational classification systems and also relate them to the ones used to classify education and job training efforts.

This operational need resulted in a large cross-walking or linkage system that relates all the existing classification systems to each other. NOICC operates this system (the National Crosswalk Center) with the active support of all its member agencies.

Summary

Each of the four occupational classification systems was designed to analyze different aspects of "work." The DOT observes workers and writes detailed descriptions of what they do. The CPS measures employment and the personal characteristics of workers by visiting them in their homes. The OES conducts a mail survey of employers and collects the number of persons employed in occupations defined by written descriptions. The SOC tries to provide a common bridge so data collected in one system can be linked to another.

Each system collects data for a different purpose. The DOT identifies occupations and defines job titles. The CPS measures the employment status and characteristics of the national labor force. The OES seeks to track the changes in occupational employment by industry for use in the preparation of projections of employment demand for specific skills across the entire economy.

The next section describes how these different purposes and processes used by the programs influence their classification systems.

The problem

In designing a new Standard Occupational Classification that meets the needs of the workforce in the new century, it is neither necessary nor advisable to discard the historical integrity and proven strengths of the existing systems. Although almost all users would agree that the SOC is the "first and only government occupational classification system developed to provide a general framework around which data from various sources and collection efforts could be organized," [16] few would argue that the SOC fits perfectly every user need.

The problem in refining the existing SOC begins with its present use. To understand this aspect of the problem, figure 1, compares the two major collection systems, the census/CPS and the OES. The chart demonstrates that while the occupational classifications used by the

two programs may differ, they account for only one of the major differences in the two systems. While both measure occupational employment, they vary significantly in terms of employment concept, scope of coverage, and geographic detail of the data collected.

Information from the two systems complements each other. To collect details about the characteristics of the workforce, it is necessary to survey households; employers are not good sources of information about race, gender, age, etc.. On the other hand, to collect accurate data about the number of persons performing a particular job in a specific industry, by State, it is necessary to survey a large sample of employers. To integrate the information produced by each, it is essential to use compatible classification systems.

Constraints of time, training, and funding define the degree of accuracy and the amount of detail collected. To better understand these built-in "hurdles," this section describes the collection and classification procedures of each system.

The explanation and discussion prove the need for answering the important question this paper addresses: How can a new SOC best collect information from both households and employers?

Figure 1. A comparison of the two collection systems

Category	CENSUS/CPS	OES
Purpose	"determine one's labor force classification," [17] collect and display data	collect and display data "efficiently, consistently, and understandably" [18]
Enumerates	counts people	counts jobs
Method	personal interview	mail survey
Geography	place of residence	place of work
Universe	occupied households (adults living under one roof)	business establishments (economic units produce goods/provide services)
Employment coverage	all employed adults, 16 years and older	employees who receive salary or wages (but not agriculture, domestics, self-employed)
Sample size	60,000 households monthly	700,000 establishments during 3 year cycle
Classifying method	by job title, duties; coded by Census Bureau	by written definition; classified by employer
Occupational classification	3-digit code; job titles for industry and for occupation	5-digit code; occupational title; written definition
Strengths	includes workers' characteristics; historical continuity; personal contact with respondent; local estimates	excellent written job definitions; large sample; covers economy in 3 years; prepares estimates by State

Census/CPS collection process

"Problems in obtaining reliable industrial and occupational data are almost as old as the republic. James Madison proposed that the initial 1790 census classify workers by industries in which they were employed (agriculture, commerce, or manufacturing) but the Senate rejected the proposal without recording the basis for disapproval." [19]

The first decennial census counted persons without regard to industry or occupation or employment. In fact, until the Great Depression "no direct measures were made of the number of jobless persons. Mass unemployment in the early 1930's increased the need for statistics." [20] By 1942, the Census Bureau was counting persons for the "Monthly Report on the Labor Force." This household survey became part of the Current Population Survey in 1948. Analyzing CPS data became the responsibility of the Bureau of Labor Statistics in the late 1950's.

During the week containing the 19th of the month, the Census Bureau interviewer contacts a responsible person in each of 60,000 households in the scientifically drawn sample.

The interviewer must classify all civilians, 16 years of age and older, who are not institutionalized, into three categories: Employed, unemployed, and not in the work force. If a household member is employed, then the interviewer asks: "For whom did he/she work? What kind of business or industry is this? What kind of work was he/she doing? What were the most important activities or duties?" [21]

Enumerator problems

The interviewer records, by hand, the responses verbatim with no interpretation. Unclear or inaccurate answers may be provided. The interviewer may squeeze "job duties" into a small space and, often, the results are difficult for the classifying clerks to read. Interviewers must sometimes enter dangerous neighborhoods where residents, suspicious of surveyors, may provide less then complete information. Because many interviewers are part-time and temporary employees, their training, experience, and personal skills vary greatly.

The interviewer maintains a control card of historical information about the household, its survey code, location, number of individuals, etc. No information is maintained on the occupation or industry from the previous month. By 1994, laptop computers will replace all paper forms and may expand the historical information available to the interviewer.

The CPS, like any collection system, has built-in areas of error. First, all selected households may not respond. Some may not answer certain questions. "Any resistance of the population to participate in surveys increases the costs of the method," noted two researchers.[22] In any given month, 7 percent of the sampling may refuse. This "non-participation in the survey appears to be increasing

in the United States and in many other western societies," observed the same study.[23]

Second, the experience and skill of the interviewer may affect the results. One study found that experienced interviewers did indeed garner a higher response rate, but the study could not isolate and identify the characteristics to account for the difference.[24]

Classifying/coding procedure

Once completed, the paper questionnaires are shipped to the Current Projects Branch, Data Preparation Division, at the Census Bureau facility in Jeffersonville, Indiana.[25]

Workers first separate out those questionnaires that contain no interview or contain responses from someone in non-labor categories. Then, the forms are bundled into work units of 50 and sent to the coding room where the statistical assistant uses the Alphabetical List of Industries and Occupations, in both printed and electronic formats, to code industry and occupation. To check consistency of the industry, the coder also refers to the employer name lists (arranged by geographic area with other information and industry codes); to confirm the consistency of occupation, the coder compares the response with the question about "class of worker" (that is, farm, government, self employed).

Split-screen computers, showing the questionnaire at the top and the employer name list or alphabetical list at the bottom, assist the statistical assistants. Once coded, the questionnaires are read by an optical scanning device (FOSDIC) and the data are transmitted to the Census Bureau in Washington.

Classifying/coding problems

The classification clerks are expected to code accurately about 30 forms per hour. Each coder is required to follow a very rigid set of procedures in classifying the job titles. If followed correctly, the process leads to a specific classification decision. "I code what I see," reports one statistical assistant.[26] When coders are not sure about what they see, they place a green slip in the questionnaire booklet and send it to the referral room. There, more experienced reviewers use references (for example, Dunn and Bradstreet, State directories of manufacturers, the DOT, the SOC) and knowledge to make judgements on the appropriate code.[27] The classification decisions made by the initial coding clerks, are reviewed every month. After processing and transmitting the information, supervisors select a 10-percent sample of questionnaires and test the accuracy of their coding. Two additional clerks re-code, independently, the same industry and occupation information. If both of the reviewers disagree with the original coder, it is considered a mismatch. This process is followed to test whether the original coder rigidly followed the classification procedures. If a certain number of mismatches occur, the original coder must re-qualify.

This system of quality control emphasizes consistency in following the coding process. Because the data collected can easily be interpreted in more than one way, and because more than one code can be justified, the processing center insists that coders follow the process.

Problems in meeting the production quota include:

- Format—small boxes, recorded in pencil
- Hand writing—hard to read, bad spelling
- Ambiguity—"scientist, technician, analyst" have many meanings in various industries
- Contradictions—an immunologist has only a high school education
- Limitations—inadequate employer name lists

The census/CPS as a research data base

The experienced classification and coding staff at the Census Bureau facility in Jeffersonville, Indiana are continually monitoring changes in the job titles they receive through the collection process. When a new title is reported repeatedly it is catalogued and forwarded to the national office for possible inclusion in the computerized Alphabetical Index of Industries and Occupations. After a careful review the national office decides whether to introduce the new job title into the system.

Over the course of months and years, these referrals and actions are accumulated and may constitute an important resource base for the revision of the SOC, or other classification system, such as the DOT. In addition, the census coding process, its training materials, and experienced staff provide a very valuable resource to any agency that is involved in coding job titles into occupational categories. For example, the Employment Training Administration is in the process of introducing such coding into the JTPA follow-up process. Similarly, many State vocational education agencies follow-up program completers by collecting and classifying job titles. The Census Bureau experience and training materials could be very useful to these agencies.

OES collection system

The Census occurs only once every 10 years and the Current Population Survey interviews a small sample population each month. Although both collect details on occupation and geographic area, the information is often too old (census) or too limited (small CPS sample) to help State employment security agencies (SESA's) and other users. The Bureau of Labor Statistics responded to these needs by establishing a cooperative program with SESA's, the Occupational Employment Statistics program, which now surveys about 700,000 business establishments in 400 detailed industries.

By collecting information over a 3-year cycle, this program released States from almost total dependence on census information with its attendant problems, and resulted in the availability of accurate up-to-date information on occupational employment.

BLS selects the occupations, designs and prints the forms, and distributes them to the States. From lists of businesses which contribute to the State unemployment insurance program, the States select a sample of establishments stratified by size class. All establishments with 250 employees or more are included. A formula determines the inclusion of smaller establishments. A questionnaire is mailed to each establishment and includes occupations usually found in particular industry, with appropriate job titles and definitions.[28]

The employer simply enters the number of workers that are employed in each occupational category for the pay period which includes the 12th of the month. Supplemental sheets allow the employer to specify job titles for workers who fall into the "all other" residual category or the employer feels may be of special interest. The forms are returned to the State agency for processing. Estimates of occupational employment are computed following BLS estimating procedures and the results forwarded to BLS and published by the SESA. These data are accumulated through the 3-year survey cycle and are used as the data base for the preparation of projections of occupational employment.

Respondent problems

Employers have proven to be reliable, accurate sources of occupational employment information. The response rate for the survey is nearly 80 percent.

Early testing demonstrated the need for written definitions.[29] Most employers respond using the questionnaire. Some (about 10 percent) simply submit a list of their occupations. In these instances, the State agency classifies the employer job titles into the OES occupations.

Some problems occur in specifying the occupation of workers in residual categories (on the forms) and in job titles (on the computer lists). Few problems are encountered in processing the original responses. Those that occur are followed up by State personnel.

But in such a large sample there are bound to be exceptions. Some employers make excessive use of residual categories. Others have difficulty with the supplemental sheets for occupations not listed on the survey form. And, as indicated above, about 10 percent of establishments submit occupational (computer) lists that must then be classified and coded.

Special care is taken in the small number of cases where the employer submits a list of job titles. "Firms occasionally use inflated language," according to an OES training manual.[30] "Analyst, coordinator, technician, head, and chief" lead the list of inflated titles. Ambiguity may also appear on these employer job title lists such as "quality control," "quality assurance," or "quality engineer." Does a "customer service representative" handle complaints on the telephone, or sell products on site? Is a "field service representative" someone who fixes the product or sells it? Abbreviations can confuse. Does the "Pr Mgr" manage a product? a program? a project?

Classifying/coding problems

Research has shown that most employers classify, code and report occupational employment accurately.[31] If necessary, the State agencies conduct telephone follow-ups where clarification is needed. Most reporting errors occur when inexperienced personnel complete the questionnaire. Because an employer is contacted only once in 3 years, there is no assurance that consistency in reporting is maintained between survey cycles. Presently, there is no procedure to cross check an employers' current response with the previous survey. Consistency in reporting is an important issue. Maintaining continuity is of vital importance in the preparation of employment projections.

Some classification problems occur when the employer chooses to submit a list of occupations rather than complete the survey form. Coding employer job titles involves many of the same difficulties faced in the Census classification process. However, the OES classifiers are highly trained. When encountering difficult questions, they simply telephone the employer for clarification.

It should be noted that the employer responses on the supplemental sheets are retained by BLS and form a very valuable resource for use in revising the SOC and the DOT.

Summary

The two principal occupational employment collection systems face constraints in obtaining accurate, detailed information from respondents. Available resources limit the number of households or establishments that can be contacted. The 10-year cycle severely limits the usefulness of the Census. The small sample used by the CPS limits it to national information as do the difficulties of classifying job titles. The training and experience of CPS enumerators and coders influence outcomes. The OES does not cover employment in important areas such as agriculture and the self-employed and produces only national and State level data.

At first glance, the list of hurdles in the path of accurate, detailed data collection seems formidable. Yet, differences in these occupational classification systems may not be a major obstacle.

While the collection processes of the OES and Census/CPS differ substantially, the capacity of these data bases to complement each other rests, in part, on the comparability of the respective occupational classification systems. The next section will examine the relationship of both the OES and the census/CPS classification systems to the SOC.

Crosswalks and analysis

Users of occupational data may perceive a problem because they may assume that a system that doesn't meet their needs can't meet any needs. Before revising the

SOC, it is useful to examine the historical record and determine any trends. It is also important to find out if the CPS and OES conflict with the SOC, as many presume.

In this section, tables display how the SOC relates to the census and to the OES. Emphasis is placed on the types of matches between SOC and the other two systems. There are four types of matches: Direct; combination A—census (or OES) to the SOC; combination B—SOC to the census (or OES); and no match.

Specifically, table 1 presents a historical comparison. Tables 2 and 3 show relationships between the census and the SOC. Matches are presented in both summary (table 2) and detailed by occupation (table 3) formats. Tables 4 and 5 show relationships between the OES and the SOC. Matches are presented in both summary (table 4) and detailed by occupation (table 5) formats.

Table 1. Historical summary

Table 1 answers the important question, "What was the relationship between CPS and OES when the SOC was first introduced?"

The three systems varied greatly in their respective coverage of occupations. The Decennial Census of 1970, which became the basis for questions in the monthly surveys of the 1970's, included only about one-fourth of the number of occupations listed in the OES (423 vs. 1,606). The SOC fell in the middle: 60 percent more occupations than the census, but about 60 percent less than the OES.

Examining broad occupational groups reveals even larger disparities. For example, in blue-collar fields (production, construction, etc.), the census collected data on 165 occupations, the OES on 1,114, and the SOC on 285.

Similar, if less pronounced, differences exist in nearly every broad occupational category. The professional and technical group, along with precision production, craft, and repair occupations account for 50 percent of the census and 40 percent of the number of occupations included in the SOC.

One plausible reason for the differences is the intention of OES, in its early development, to present a clear picture of employment in all occupations. Gradually, OES reduced the number of occupations covered in the machine operating categories and expanded those that required more education and training.

Tables 2 and 3. Census: SOC

Tables 2 and 3 compare occupations counted in the 1990 decennial census with those in the SOC. Has the census changed? Has it become more compatible with the SOC than it was earlier?

Since 1970, the census increased the number of occupations by almost 20 percent, from 423 to 502. Nearly all of these additions were introduced in the 1980 census and resulted largely from the Census Bureau involvement in the development of the first edition of the SOC. This expansion nudged the census into much closer alignment with the SOC. Nevertheless, major differences remain. For example, the census collapses many of the SOC occupations. Do these differences indicate serious incompatibility? Or are they a natural result of the collection process?

Because the census visits households, it must depend on the knowledge and sophistication of the respondent. This person may not be able to distinguish occupations that are closely related and whose title depends on the level of skill. For example, a metalworking machine operator may self report as a machinist or as a set up operator. A sales representative may not identify the service or product as required by the SOC classification. A clerical supervisor may not specify the type of personnel supervised.

To compensate for these difficulties in collection, the census classification system often collapses or aggregates occupations. The SOC, however, distinguishes between those who set up and those who operate a machine, between salespersons who sell electronic equipment and those who sell automobiles, between supervisors of information clerks and supervisors of record clerks.

These examples, however, do not prove that the census and SOC are incompatible. On the contrary, exceptions prove the rule: Nearly all the occupations in the two systems match directly or at some level of aggregation. The matches are of three varieties: Direct; adding two or more SOC occupations to a single census; and, combining two or more census occupations with two or more SOC's.

For some users, such aggregations reduce the utility of the information, while for others they may have little impact.

A direct classification match occurs when a single census occupation matches exactly with a single SOC occupation. Some examples of direct matches include:

Census occupation		SOC occupation	
Code	Title	Code	Title
043	Architect	1610	Architects
087	Optometrists	2810	Optometrists
224	Chemical technicians	3831	Chemical technicians
313	Secretaries	4622	Secretaries
484	Nursery workers	5619	Nursery worker
573	Drywall installer	6424	Drywall installer

In table 2, 381 of 667 SOC occupations (57 percent) directly match a single census occupation.

Directly matched occupations occur in more than half of the categories in most major occupational groups.

Table 3 shows that the number of direct matches is even higher for the occupational groups used most often in educational and career planning (professional, technical, service, transportation, and administrative support).

Direct matches account for 75 percent of all SOC occupations in these groups.

As might be expected, the production working group offers the least number of direct matches, only 19 of 118. Because the two systems classify workers differently, this discrepancy is understandable. The SOC separates set up workers from operators, for example, but the census cannot distinguish and, therefore, must combine these workers into a single occupation.

The second type of match results from adding two or more SOC occupations to a single census. These combined matches account for most of the remaining matches. Combining 265 SOC occupations provides matches with 87 census occupations. Examples include:

Census 055, Electrical and electronic engineers
- SOC 1633, Electrical and electronic engineer
- SOC 1636, Computer engineer

Census 069, Physicist and astronomer
- SOC 1842, Astronomer
- SOC 1843, Physicist

Census 229, Computer programmer
- SOC 3971, Computer programmer, business
- SOC 3972, Computer programmer, scientific

Census 479, Farm worker
- SOC 5612, General farm worker
- SOC 5613, Field crop and vegetable farm worker
- SOC 5614, Orchard and vineyard and related workers
- SOC 5615, Irrigation workers
- SOC 5617, Livestock workers

Census 523, Electronic repairers, commercial and industrial equipment
- SOC 6151, Communication equipment repairers
- SOC 6153, Electrical & electronic repairers of commercial and industrial equipment
- SOC 6155, Electronic repairers, home entertainment

In the production working group, 84 percent of the SOC occupations could be combined to match a single census code.

In the precision production subgroup, additional matches resulted from combining the census enumeration of apprentices with the related craft occupation. For example, SOC 6422, carpenters, includes census 567, carpenters and census 569, carpenter apprentices. The same method holds true for SOC 6813, machinists, which includes census 637, machinists, and census 639, machinists apprentices.

By combining multiple SOCs to match a single census occupation, and by combining multiple census occupations to match a single SOC, it is possible to match 95 percent of the occupations enumerated in the 1990 census with those listed in the 1980 *SOC Manual*.

Table 4. OES: SOC, Summary

When it began in the early 1970's, the OES covered 1,600 occupations, many more than either CPS or SOC. This large number met two needs: it identified the full range of occupations in the workforce, and it acknowledged the concerns of State cooperating agencies for complete coverage in their State.

Beginning in 1983, the focus shifted towards occupations that contained a significant number of workers and/or required a significant amount of skill training or educational preparation. Many occupations that didn't meet these criteria were removed so that by 1992 the list had been reduced to about 750 (that is, less than half of the original).

As each round of the survey identifies new occupations, the BLS reviews and updates the list continuously.

Table 4 shows that most of the deleted occupations were in "blue-collar" fields: from 1,100 in 1980 to 400 in 1992, a decline of 60 percent. Many of these deletions represented machine operating specialties, evident in only a few select industries, whose skills were usually learned on the job. Occupations requiring little skill or employing few workers were also removed.

Table 4 also points out two important differences in classification. There are a number of areas where the SOC includes occupations in greater detail than the OES. Usually, the reverse is true. For example, SOC asks employers to identify salespersons by the type of product they sell; OES focuses on the task (selling), not the product. Employers may find it difficult to report accurately when their sales force sells several products. Extended training and product knowledge may be a prerequisite for selling computer systems, but not for sporting goods.

The second difference in classification reflects the limited scope of the survey. Because the OES survey sample is drawn from the list of employers contributing to the State unemployment insurance program (ES 202), it is limited to wage and salary workers in nonagriculture industries. Therefore, OES does not cover several million workers engaged in agriculture production or self-employment. These omissions affect the occupational list covered by the OES. For example, the SOC includes 15 occupations that are solely employed on farms, the OES, none.

Table 5. OES: SOC, detailed format

Table 5 shows that 296—nearly 40 percent—of the OES occupations have a direct match with SOC occupations. Another 356 OES occupations can be simply combined to match SOC occupations. In total, 652 of the 768 OES occupations— 85 percent—match the SOC directly or in combination. (In contrast, when matching CPS to SOC, most matches are the result of combining two or more SOC's to a CPS occupation).

Table 5 demonstrates how the OES provides important occupational detail, especially in the professional, tech-

nical, precision production, maintenance, and construction craft categories. In these groups, 55 SOC occupations were broken down into 162 OES occupations. The OES level of detail greatly aids in program planning and career guidance uses. (By contrast, the census collapses SOC coverage by more than 30 occupations in these three categories.) Shown below are three examples of the expanded OES coverage.

1. Health aides, except nursing (SOC 5233)
   (a) Medical assistants (OES 66005)
   (b) Physical and corrective therapy aides (OES 66017)
   (c) Occupational therapy aides (OES 66021)
   (d) Pharmacy aides (OES 66026)
2. Secretaries (SOC 4622)
   (a) Legal secretaries (OES 55102)
   (b) Medical secretaries (OES 55105)
   (c) Other secretaries (OES 55108)
3. Heavy equipment mechanic (SOC 6117)
   (a) Underground mine machinery mechanic (OES 85117)
   (b) Mobile heavy equipment mechanic (OES 85314)
   (c) Rail car repairers (OES 85317)

In the first example shown above, health aides, except nursing, the OES breaks out four occupations that are combined in the SOC. The additional detail shown by the OES is of great importance to users. For example, each OES occupation requires different skills and is reached through a very different training or education program.

In some instances, two or more SOC occupations must be combined to match an OES occupation: 184 SOC's collapse into 47 matches with OES. For example, in the professional occupational group, 31 SOC's combine to match 11 OES occupations; most occur in post-secondary teaching specialties, separated in the SOC, but combined in the OES. In the sales occupational group, OES 49005, sales representative, scientific and related products represents nine SOC technical sales occupations (for example, technical sales worker, aircraft, SOC 4232). In the production working group, the SOC separates a number of metalworking operating occupations while the OES combines them. Thus, while the number of OES combinations to SOC seems large, most result from the constraints of the collection process or are of minor importance to users. Many of the occupations combined by the OES require little specific training or are reached through the same career or educational path. In these cases, additional occupational detail would be of little value to most users.

In a few instances, multiple combinations are needed to create the match. For example, OES computer programmers (OES 35105) plus all other computer scientists (OES 25199) match two SOC occupations, computer system analyst (SOC 1712) and computer scientist, not otherwise classified (SOC 1722). This example, and others like it, underscore the need to update the SOC to reflect the actual practices of the job market.

There are instances where the SOC and OES differ significantly in covering the occupational field, for example, the printing and printing machine operations occupations. The OES has restructured many of the printing occupations listed in the SOC to better reflect the occupational skills currently used in the printing process. The SOC revision should review these occupations carefully.

Overall, tables 4 and 5 demonstrate a high level of compatibility between the OES and the SOC classification systems. Where differences occur they generally result from the increased number of occupations covered by the OES. The OES system should provide a major resource in the revision of the SOC. In addition, the supplemental sheets completed by the employers could provide a valuable source of information for revising the DOT.

Conclusions and recommendations

"When we do an assessment or survey, we create the expectation that the data will be used for decision-making purposes," asserts management expert Stephen Covey.[32]

User needs should be an important consideration in any classification system used to collect occupational data. The constraints of the collection process and the availability of resources must also be considered. After examining the SOC and the two major occupational data collection programs and their respective classification systems, several basic conclusions may be drawn.

First, the SOC already provides a classification structure for collecting data from both households and employers. A revised SOC will accomplish even greater gains.

Much has been accomplished in drawing together the OES and census/CPS classification systems. The SOC has played a major role in that process. Differences exist, stemming from the limitations imposed by the collection process or the need to update the SOC. The revised SOC should expand the occupational list and improve the written definitions.

Second, the SOC requires a major revision. The OES includes well over 100 occupations not shown in the SOC. Often these additions reflect new occupations that have emerged since the 1980 SOC was published. The current OES system should be of great value in that revision process.

Third, NOICC facilitates the compatibility of the census/CPS and OES collection systems and extends their benefits to many users.

Historically, NOICC has attracted many users (for example, CIDS, military) to the SOC. Its assets enable many diverse users to better use collected data. Compatible classification systems are essential for the continued success of its occupational information system.

Finally, the objective should be classification compatibility not the development of a single list of occupations for use in both household and employer surveys.

The currently proposed revision of the SOC offers an excellent opportunity to continue the progress made towards a uniform occupational classification system. However, attaining the objective of a single list of identical occupations covered by the two collection systems will not occur. The constraints of their respective collection processes will continue to dictate compromises and adjustments. It is important that these modifications continue to be made within the structure of a revised SOC system to retain compatibility.

Recommendations

The following recommendations cover two general areas: (A) those related to a proposed revision of the *Standard Occupational Classification System Manual;* and (B) those directed towards institutionalizing and maintaining an updating process for the SOC.

A. Proposed revision of the SOC.

(1) Build on the past; establish clear administrative and technical guidelines. The revision of the SOC will require a number of administrative and technical decisions. The revision should be conducted in an administrative environment and with a collaborative process similar to those used in the development of the original SOC. As with the SIC, the original SOC was developed by the Statistical Policy Division of the Office of Management and Budget, Executive Office of the President. The revision of the SOC should be coordinated by a similar policy organization to ensure cooperation. The revision process should allow the broad involvement of data developers and users. NOICC's unique membership composition could assist this activity. The original principles and structure of classification used in the 1980 SOC 33 should be retained to ensure continuity with historical data.

(2) Expand the number of occupations. The number of occupations included in the SOC should be expanded. Many new occupations have surfaced since 1980 and they should be added. The current OES list of occupations should be used as a list of occupations considered for the revised SOC. The 1990 census identified several new occupations that should be part of this preliminary list.

(3) Expand the SOC definitions; make them complete and concise. The written occupational definitions shown in the 1980 SOC are usually very brief and inadequate for collection of employment data. In a revised SOC, each occupation should have a concise but complete definition, be acceptable to the user community and meet data collection needs. The long list of DOT titles, with no measure of their employment size, does little to improve the users' understanding of the occupation and should be eliminated. Some mechanism should be developed that allows the user to easily cross reference the SOC occupation to the DOT. This might be accomplished by simply using the SOC structure in the revised DOT.

(4) Include useful cross references. Several important cross references should be included as integral components of an occupational definition. Included should be: the 1990 census occupation code(s) and title(s); the OES code(s) and title(s); primary industries (3-digit SIC's) of employment based on the OES program.

B. Establishing an occupational classification maintenance and up-dating system.

(1) Plan revision of the SOC on a regularly scheduled cycle. Perhaps, the most appropriate timing would place them on a 10-year cycle immediately preceding the decennial census of population. Equally important, a mechanism or process should be established that allows for the continuous assembling of information on new occupations. A mechanism is needed to continually monitor, record and periodically introduce these changes into the SOC and other classification systems, such as the DOT.

(2) Add addenda to the SOC periodically. Addenda could be added to coincide with the three-year cycle of the OES establishment collection program. It is crucial that updates be scheduled at specific intervals.

(3) Establish a single classification information center. Presently, a considerable amount of intelligence on occupational change is captured during the DOT, OES/OOH and CPS collection and analysis process. Currently there is no single repository of occupational classification information. One should be established.

(4) Select a qualified agency to operate this center. Much of the data and research capabilities are located at the BLS and ETA. Classification issues would seem best served if BLS were identified as responsible for compiling and maintaining this information.

Notes

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[25] The author spent an entire working day observing classification and coding procedures at the Census Bureau Processing Center in Jeffersonville, Indiana. In addition to interviewing Theodore Sands, Chief, Current Projects Branch, the author talked to supervisors and sat next to statistical assistants and reviewers as they performed their tasks. "Coder" refers to an employee who makes decisions about the appropriate classification and code for a CPS questionnaire.

[26] Interview, a statistical assistant. (April 1993) Jeffersonville, Indiana.

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Table 1. Historic compilation of occupational coverage, 1970 Census, 1980 OES, and 1980 SOC

Occupation group	1970 census		1980 OES		1980 SOC	
	Number	Percent	Number	Percent	Number	Percent
All occupations	423	100.0	1,606	100.0	663	100.0
Executive, administrative, managers, etc.	23	5.4	16	1.0	42	6.3
Professional and technical	124	29.3	235	14.6	147	22.2
Sales	14	3.3	18	1.1	47	7.1
Administrative support, includes clerical	46	10.9	131	8.2	66	10.0
Service	41	9.7	81	5.0	48	7.2
Agriculture, forestry and fishing	10	2.4	11	0.7	28	4.2
Production, construction, crafts, operating maintenance, and other	165	39.0	1,114	69.4	285	43.0
Precision production, crafts, etc.	88	20.8	NA	NA	113	17.0
Production working	52	12.3	NA	NA	115	17.4
Transportation	15	3.5	NA	NA	27	4.1
Handlers, cleaners, laborers, etc.	10	2.4	NA	NA	30	4.5

Note: Counts of occupations depend upon sources, time periods, and the analysts' choices and therefore may differ from counts by others.

Table 2. Census to SOC occupational coverage, 1990 Census to 1980 SOC

Type of relationship	Occupation counts			
	1990 census		1980 SOC	
	Number	Percent	Number	Percent
Total, all occupations	500	100.0	667	100.0
Matched occupations	495	98.4	662	99.0
Direct matches (one to one)	381	75.7	381	57.0
Combined matches	114	22.7	281	42.0
2 or more SOC occupations combined to a single census	87	17.3	265	39.6
2 or more census occupations combined to a single SOC	27	5.4	16	2.4
Nonmatches	5	1.6	7	1.0

Note: Counts of occupations depend upon sources, time periods, and the analysts' choices and therefore may differ from counts by others.

Table 3. Census to SOC occupational coverage by groups, direct and combined matches

Occupational group	Number of occupations		Matches						Nonmatches	
	1990 census	SOC	Direct		SOC combined to census		Census combined to SOC		Census	SOC
			Census	SOC	Census	SOC	Census	SOC		
Total all occupations	500	667	381	381	87	265	27	16	5	7
Executive, administrative, and managerial	28	46	22	22	5	24	0	0	0	0
Professional specialty	106	115	98	98	8	17	0	0	0	0
Technicians and related support	22	28	22	22	2	6	0	0	0	0
Marketing and sales	23	47	17	17	6	30	0	0	0	0
Administrative support, including clerical	55	66	50	50	5	16	0	0	0	0
Service	45	48	38	38	4	9	3	1	0	0
Agriculture, forestry, fishing and related	19	28	14	14	4	14	0	0	0	0
Precision production, craft and repair	101	114	65	65	12	30	24	16	2	2
Machine operatives, assemblers, and inspectors	61	118	19	19	38	91	0	0	2	3
Transportation and material moving	24	27	22	22	1	3	0	0	1	2
Handlers, equipment cleaners, helpers and laborers	16	31	13	13	3	18	0	0	0	0

Note: Counts of occupations depend upon sources, time periods, and the analysts' choices and therefore may differ from counts by others.

Table 4. Comparison of 1992 OES to 1980 SOC, occupation coverage

Type of relationship	Occupations			
	OES		SOC	
	Number	Percent	Number	Percent
Total, all occupations	768	100.0	667	100.0
Matched occupations				
Direct matches (one to one)	296	38.5	296	44.4
Combined matches				
2 or more OES occupations combined to a single SOC	356	46.4	117	17.5
2 or more SOC occupations combined to a single OES	47	6.1	184	27.6
2 or more SOC's and 2 or more census combined to a match	51	6.6	36	5.4
Nonmatches	18	2.3	34	5.1

Note: Counts of occupations depend upon sources, time periods, and the analysts' choices and therefore may differ from counts by others.

Table 5. 1992 OES to 1980 SOC, occupation coverage by groups

Occupational group	Number of occupations		Matches						Grouped matches		Nonmatches	
	1992 OES	1980 SOC	Direct		OES combined to SOC		SOC combined to OES		OES	SOC	OES	SOC
			OES	SOC	OES	SOC	OES	SOC				
Total all occupations	768	667	296	296	356	117	47	184	51	36	18	35
Executive, administrative, and managerial	41	46	20	20	16	3	4	21	0	0	1	2
Professional specialty	117	114	57	57	39	16	11	31	8	9	2	1
Technicians and related support	41	28	16	16	23	7	2	5	0	0	0	0
Marketing and sales	21	47	9	9	5	2	7	36	0	0	0	0
Administrative support, including clerical	77	66	30	30	43	15	4	19	2	2	0	0
Service	66	47	23	23	36	11	0	0	7	6	0	7
Agriculture, forestry, fishing, and related	21	28	3	3	6	2	0	0	6	2	6	21
Precision production, craft, and repair	184	114	67	67	100	32	3	12	14	7	0	8
Machine operatives, assemblers, and inspectors	134	118	40	40	65	24	12	42	6	6	11	8
Transportation and material moving	46	27	17	17	23	5	2	4	4	1	0	0
Handlers, equipment cleaners, helpers, and laborers	20	31	14	14	0	0	2	14	4	3	0	0

Note: Counts of occupations depend upon sources, time periods, and the analysts' choices and therefore may differ from counts by others.

Discussion

ELEANOR DIETRICH: On your (For Donna Dye) recommendations 3 and 4 for the classification of the DOT, is APDOT recommending that the Standard Occupational Classification system equal what we're going to do in the DOT? The fourth recommendation said there might be some flexibility in how much you collect. Would there be differentiation maybe within a broader occupational group at the DOT level or are we just talking about one level that would equal the SOC?

DONNA DYE: Well, I think you talk about classification not in the sense of a DOT classification, but of the single classification system. It's a single classification that we would all use, that we would all subscribe to. From that though, if there isn't enough differentiation, for the collection methodologies or analyzing of the data, then the DOT would add to the list, but it would keep the overall classification system and then move from within there.

As a further clarification point on that, because the APDOT felt it was important that we not wait until 1997 for implementation of this, particularly as it concerns occupational classification, it recommends that the Department of Labor consider initiating change by using the OES as a starting point, to do that almost immediately. Then as this body or whatever the next body that's going to work on classification works on this, that those changes would be included in that, but to adopt the OES right now as the classification system for the DOT. What we would do then is where there's need for more differentiation within the OES, then we would add that in order to meet the specific DOT users' needs.

KAY RAITHEL: When you (David Stevens) were developing your tier 1 and tier 2, were you really thinking about improving all of the DOT's and then run the two tiers or were you thinking of something more abbreviated?

DAVID STEVENS: No, there's a very close to explicit tier 3 that I would have eliminated occupations, which is what I really intend when we say we're going to cover all occupations. If we choose to do that, if we really seriously say we're going to cover all occupations, in my opinion we're absorbing resources in a symbolic exercise that's taking away from resources that could be put to better use. That's easy for a professor to say perhaps and then go back to my safe ivory tower. They're not going to be easy choices. In any one of those 13,000 occupations that's eliminated somebody is going to say, hey, I know that.

KAY RAITHEL: Do you have an estimate of the number?

DAVID STEVENS: Something less than a thousand.

PETER ELIAS: I am a little bit concerned that there might be some ideas developing about DOT and standard occupational classification which might create the impression that there's going to be a sufficient amount of work taking place over the next few years that somehow is going to resolve the problems that stem from the use of different classifications. The idea, of course, is that if we have one SOC, one DOT, then we've resolved the problems of occupational classification.

So, I want to talk a little bit about DOT as the basis for SOC. Is it feasible and how will it be achieved? Feasible? Obviously, and it will be achieved in much the same way that the relationship between DOT and SOC has been achieved in the past. Maybe more work will go into it this time round; maybe more consideration might be given to the way in which DOT and SOC are slotted together. But the outcome of this process will be an SOC defined in terms of DOT.

What's important here though is not the definitions within DOT, but the definition at the lowest level of the SOC. What is the building block for statistical purposes, for counting purposes as it's been put here? What I'm talking about is, Are we going to be using 200 building blocks, 500 building blocks, 1,000 building blocks, or 2,000 building blocks? How are we going to determine this issue?

Now, it's important, I think, to look at what's been going on in other countries in this respect. But I just want to raise what I think is a very important point here. That is, it doesn't matter how much work we put into the definitions within DOT. At the end of the day, the kind of information that we're going to generate from censuses and surveys, from vacancy information, from unemployment statistics and so on, is going to arise because somebody somewhere takes a piece of occupational information and assigns some code numbers to it.

What are those code numbers? They're certainly not DOT codes. The reason for that is that we usually cannot identify occupations at the most detailed level. Of course we can if we have all the time in the world, the patience, the money, the resources to question, to explore and to find out about these occupations, and this can often happen in a career counseling situation. So, that's where we get these requests from individuals, tell me about occupation XYZ. Where XYZ is very specific and can be located in DOT and the person can be given the definition, that's great and that's what DOT is for.

But then the next question is, tell me about the prospects for this occupation. Tell me what's going on in the States. Tell me what's happening here with respect to this particular occupation or group. At this stage, we

have to turn to the information that's being developed from the sort of counting functions, from censuses and surveys. That's where I say that's information where somebody has put some code numbers against a piece of occupational information. That occupational information is typically derived from one or two short questions. Sometimes the coding of that information is centralized. Sometimes it's decentralized. Sometimes employers are left the task of coding the information. Sometimes interviewers code the information. Sometimes it's a centralized coding team somewhere.

Now it appears at the moment that there are problems because there are different building blocks used from information obtained from different sources. Well, that really is a problem. So, if you eliminate that problem by defining a common set of building blocks, do you then eliminate all the problems of comparing information between different sources of information? The answer is not at all. The reason is simple. The quality of the information that's being coded determines to a large extent the code numbers that will be placed against such information. If the quality of that information is poor, we have to have some way in which we can take poor quality information and allocate it into a classification.

The information has got to go somewhere. So, if, for example, looking at the problem of the tile setters, the hard tile setters, the soft tile setters, if somebody tells us in a survey they're a construction worker, that's too vague for precise classification. So we might have a secondary question, "What tasks does the person carry out?" and scroll down there on our survey form, whatever we see, a whole list of things, laying bricks, moving things around, and in that list is "laying tiles."

Now that person might be coded as a tile setter. Chances are that they will be coded to some rather aggregate and ill-defined category, a "not elsewhere classified" category or "not otherwise specified" category within the classification. That automatically means that the quality of the information then determines how many people we count in this specific classification.

That's not the only problem that we have. Even if we define a fairly small number of building blocks for the classification, 300 or 400, all of the coding and recoding replication studies, that is studies where we've given the same information to coders and we don't tell them what the original code was but tell them "code it again," show coding replication rates running currently in the region of 75 to 80 percent, which means 1 time in 4, 1 time in 5 it's the coding process alone which is going to put people into different occupational categories. That of course plays havoc with people who engage in occupational mobility studies if they're not aware of the fact that much of the mobility they observe is in fact code variation. This is a very serious problem.

How do we address these problems? Well, in my view, we have to start from a common index that everybody who is coding occupational information is using. This index forms the very heart of the coding process. If we lay down an index reference, then people can go away and they can reconstruct this information into whatever classification they want.

And we mustn't think that just because we have a standard occupational classification that we will not move away from the situation where different users of classifications and different producers of classifications have tampered with the edges and moved away from the standard because it fits better with the purpose that they're collecting the information for.

We mustn't think that simply because we have one DOT and one SOC that all of these problems are removed. Much more emphasis needs to be given to the nature of the coding index that's being used and the way in which we lay down information on the statistical record from the coding index, the way in which we subsequently aggregate that information, the flexibility we give to users to perform their own aggregations.

BERTHA KING: Over the years I've had an opportunity to work with SOC and DOT and so forth, with OPM and NOICC (National Occupational Information Coordinating Committee) and all the different groups.

But my concern, and I want to reemphasize what Dick Dempsey said earlier, is in education. We need to know how to get the instructional codes, educational instructional codes from the level of whatever system we come up with, classification system, into a workable, useable format for us to collect the data that we desperately need particularly in vocational education and some of the others.

We have our system, but I don't feel comfortable with it. I've worked with the people in identifying the occupations that we should prepare for, and as our society changes we need desperately to have some way to set the linkage there.

MARILYN GOWING: I have a quick comment for Mr. Dempsey. I think you were basing your integration of the SOC and the DOT on the old version of the DOT. That's not your fault, because our report had not come out, but the new version is described now and I'd encourage you to review that. It's a different kind of database now.

Module 5. International Perspectives on Occupational Classification

Introduction

Representatives of statistical agencies from various countries describe recent innovations in the development and structure of their national occupational classification systems in the papers in this section: Richard Madden for Australia, Olivier Bertrand for France, Bart Bakker for the Netherlands, Januz Witkowski and Maria Bulinska for Poland, Tessa Staples and Ian White for the United Kingdom, and Margaret Roberts and Shaila Nijhowne for Canada. Peter Elias outlines progress in the development of a harmonized occupational classification system, developed initially for the European Community, but now also being implemented throughout Eastern European countries. Dixie Sommers describes Ohio's adoption and modification of Canada's JOBSCAN's system for that State's employment service job matching. Barbara Wootton draws on other international presentations to distill some general lessons for the U.S. SOC revision.

Australian Standard Classification of Occupations Conceptual Framework and Directions for the Second Edition

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Summary

The Australian Standard Classification of Occupations (ASCO) is a framework through which the Australian Bureau of Statistics (ABS) provides regular, comprehensive and nationally comparable statistics on Australia's workforce by level and type of occupation. Jointly developed by the ABS and the then Department of Employment and Industrial Relations as the national standard for classifying occupational data, ASCO was first used in the May 1986 Survey of Employment, Earnings and Hours, and the 1986 Census. The concepts of skill level and skill specialisation used in ASCO are the same as those adopted for the International Standard Classification of Occupations (ISCO–88).

The first edition of ASCO was intended to serve for the 10 years 1986 to 1995. As it comes to the end of its intended life, ASCO is becoming out of date because of the changes and developments in occupations brought about by widespread industry restructuring and changes to industrial awards. The introduction of competency-based approaches to training also renders the definitions of skill level in the occupations out of date.

After describing the conceptual framework of ASCO, this paper will explain the changes in the Australian industrial and training scene, and assess the implications of these changes for ASCO. It will then discuss the implications of these changes for ASCO, and the likely changes to the structure and content of ASCO so that its Second Edition will be effective over the next 10 years from 1996 to 2005.

Introduction

The Australian Standard Classification of Occupations (ASCO) is the framework through which the Australian Bureau of Statistics (ABS) provides regular, comprehensive and nationally comparable statistics on the Australian workforce by level and type of occupation. It was developed by the ABS in association with the then Department of Employment and Industrial Relations, as the national standard for classifying occupational data, and was first used in the May 1986 Survey of Employment, Earnings and Hours, and the 1986 Census. The concepts of skill level and skill specialisation used in ASCO are the same as those adopted for the International Standard Classification of Occupations (ISCO–88).

A key objective in the development of ASCO was to provide a classification which would ensure the comparability of statistics produced by all government departments and agencies, especially the ABS, the Commonwealth Employment Service (CES) and the then Department of Immigration, Local Government and Ethnic Affairs (DILGEA). Prior to the publication of ASCO, the ABS, CES, and DILGEA all used different occupation classifications. The deficiencies in these classifications and the absence of a standard classification for nationally comparable occupation statistics were identified in a number of government committees during the 1970's, including the Committee on the Integration of Data Systems, April 1974; Review of Commonwealth Employment Service (Norgard Report) June 1977; and Working Group 2 of the Study Group on Structural Adjustment (Crawford Report), March 1979. In particular, the Crawford Report made the following observation:

"The occupation classification used by the ABS falls well short of what is required to support reasonable standards of labour market analysis. The classification is not skill oriented and in many cases occupations which require little or no skill are lumped together with highly skilled occupations under one heterogeneous occupational category."

Structure of ASCO

The structure of ASCO has four levels: Major group, minor group, unit group, and occupation. A profile of the ASCO structure and listings of the titles of the major, minor, and unit groups are shown in appendix A.

The major groups are the broadest level of the classification, denoted by 1-digit codes, distinguished from each other on the basis of skill level, and there are

8 major groups. The minor groups are subdivisions of the major groups, denoted by 2-digit codes (the relevant major group code, plus an additional digit), distinguished from other minor groups in the same major group on the basis of broadly stated skill specialisation, and there are 52 minor groups. The unit groups are subdivisions of the minor groups, denoted by 4-digit codes (the relevant minor group code, plus 2 additional digits), distinguished from other unit groups in the same minor group on the basis of a finer degree of skill specialisation, and there are 282 Unit Groups. Finally the occupations are subdivisions of the unit groups, denoted by 6-digit codes (the relevant unit group code, plus a hyphen and 2 additional digits), distinguished from other occupations in the same unit group on the basis of detailed skill level and specialisation, and there are 1,079 occupations.

Users of ASCO

A recent survey of the ASCO users known to the ABS has found that, of the 117 respondents to the survey, 29 percent were researchers and consultants; 14 percent were training and competency standards bodies; 11 percent were State Government departments; and 10 percent were organisations reporting for Equal Employment Opportunity and Affirmative Action purposes, and another 10 percent, for Workers' Compensation purposes.

The respondents could be divided into three broad groups according to use of occupation data:

- Group A (25 respondents) only used occupation data collected by other agencies;
- Group B (40 respondents) used ASCO only to sort and classify their own collections of occupation data; and
- Group C (52 respondents) used occupation data collected both by themselves and by other organisations.

Uses of ASCO

The 77 respondents (groups A and C) using ASCO data from external sources used the information for a number of purposes, including labour market analysis (56 percent), policy development (45 percent) and review (34 percent), social analysis (26 percent) and a range of other purposes such as epidemiological analysis and sample validation.

Nearly half the group used general labour force statistics classified at major group level, 32 percent used minor group level, 43 percent used unit group, and 38 percent used the most detailed occupation level. A number of users, including industry training bodies, also used statistics relating to selected occupation and/or industry groups.

The respondents using ASCO for classifying and sorting their own data (groups B and C, comprising 92 users) used the statistics for a range of activities, such as identifying the labour market sectors covered by their work (35 percent), providing career guidance and vocational guidance (32 percent), preparing data for official reporting requirements such as Affirmative Action and Workers' Compensation (50 percent) and other purposes. Forty-seven percent of the group reported direct coding of occupational information, from surveys or administrative forms and records.

Of this group, half the respondents coded the data to unit group (4-digit) level and 21 percent occupation level (6-digit).

A detailed description of the uses of ASCO is given in appendix B.

The Concept of Type of Work

During the early development of ASCO, it was planned to develop at least two distinct structures for ASCO based on a common set of building blocks at the statistical collection level—the unit group level. They were to be designated as the skill structure and the type of work structure respectively.

During user consultation, many potential users of occupational statistics commented favourably on the *Canadian Classification and Dictionary of Occupations* (CCDO) and suggested that it be used as the basis for the type of work structure. The definition of type of work originally adopted for the development of ASCO defined the concept as being concerned with what a person is doing in a job, how he/she is doing it, and in some cases why he/she is doing it. It was stated that type of work may involve the identification of materials worked on, products or services produced, and machines, tools, or work aids used.

However, in the absence of an operational definition for type of work, early drafts of the classification relied on the use of materials worked on, products or services produced, and machines, tools, or work aids used as the sole classification criterion, which were only intended as partial measures of the operational concept. This difficulty was ultimately traced to the absence of a suitable operational definition of type of work. Further research on the definition of similarity of occupations suggested that type of work as a classification criterion was not essentially different from a skill criterion. A detailed account of this research was summarised in a paper presented to the 1983 Conference of the Australian and New Zealand Association for the Advancement of Science, entitled "The Classification of Occupations According to their Intrinsic Properties" by Brian Embury.

Conceptual Basis of ASCO

In ASCO, the concept of type of work is now interpreted in terms of the set of tasks that workers in any occupation are required to perform. The basic building block in ASCO is an occupation, defined as a set of jobs with similar sets of tasks. Occupations are then classified using two criteria: skill level and skill specialisation. In other words, the classification groups occupations into successively broader groups on the basis of their similarity in terms of these criteria.

Concept of skill level

The skill level of an occupation is defined as a function of the range and complexity of the set of tasks involved. The greater the range and complexity of the set of tasks the greater the skill level. Hence, the more complex the tasks involved in any given occupation, the higher will be the skill level of the occupation. Further, an occupation which requires the performance of a wide range of tasks has a higher skill level than an occupation which requires the performance of a subset of those same tasks.

Operationally, skill level is defined as the amount of formal education, on-the-job training and previous experience required before an individual can perform that set of tasks satisfactorily. For example, the occupation of a mechanical engineer typically requires an individual to undertake 12 years of primary and secondary education, and a 4-year degree combined with significant practical experience before he or she is able to perform the set of tasks involved satisfactorily. Similarly, the occupation of fitter and turner typically requires 10 years of primary and secondary education and a 4-year apprenticeship. In ASCO, the occupation of an engineer is considered to have a higher skill level than that of a fitter and turner.

Skill level is therefore an attribute of occupations and not an attribute of particular individuals in the labour force.

The three variables used in the measurement of skill level—formal education, on-the-job training, and previous experience—are defined as follows:

- *Formal education* consists of three types: Primary, secondary, and tertiary education. Primary and secondary education are measured in years of schooling. Tertiary education is divided into categories consistent with those recognized by the Australian Council of Awards in Advanced Education (ACAAE) and the Technical and Further Education Advisory Council (TAFEAC).
- *On-the-job training* is defined as training given to a worker after he or she has been employed in the job in question. It is usually not supervised by recognized educational institutions.
- *Previous experience* for a given occupation is defined as the number of years of experience gained in other occupations that contribute to an individual's ability to perform the tasks of the occupation in question.

The determination of the skill level of each occupation in the classification inevitably involved some subjective judgement. This is particularly so with respect to the amount of on-the-job training and previous experience necessary for an individual to perform the tasks satisfactorily. In practice, current labour market requirements for entry into a given occupation were often used as an indicator. Where there was variation in the relevant data supplied from the various sources, only the most common routes of entry were used in the classification.

Although the principal application of the skill level criterion is at the major group level of the classification, it is used at the occupation level to distinguish trainee occupations (for example, apprentices) from those occupations which require the training as a prerequisite. Skill level is also used at the occupation level to distinguish supervisory occupations from the occupations supervised.

Concept of skill specialisation

The skill specialisation of an occupation is a function of four variables: Field of knowledge required, tools and equipment used, materials worked on, and goods and services produced in relation to the tasks performed.

The definitions of these variables are as follows:

- *Field of knowledge* required is defined as the subject matter essential to the performance of the tasks.
- *Tools or equipment used* is defined as the plant, machinery or hand tools used in the performance of the tasks.
- *Materials worked on* is defined as the materials extracted, processed, refined, or fabricated as an essential part of the performance of the tasks.
- *Goods or services produced* is defined as the goods or services produced as a result of the performance of the tasks.

It is therefore seen that the specific variables used to measure skill specialisation are similar to those traditionally used in the development of occupation classifications. The approach used in ASCO is essentially to extract the skill level dimension first and then to classify occupations within skill levels on the basis of skill specialisation interpreted in an appropriate manner for each particular skill level. An examination of the ASCO structure will reveal the correlation between skill level and skill specialisation.

Design Constraints

Although the structure of ASCO was based on the conceptual model outlined above, its development was constrained by practical considerations such as the frame-

work of Australian economic and social institutions; the relative significance of particular occupations in the Australian labour force; data collection possibilities in statistical censuses and surveys; and user demand for statistics on particular categories of occupations. The development was also constrained by the need for the structure to have sufficient intuitive appeal to provide the basis for its acceptance as a national standard classification.

Development of the structure of some major groups in the classification has been constrained to follow pre-existing and widely accepted classifications developed by the Australian institutional framework. An example is major group 4, tradespersons, in which the classification of tradespersons used by all State Apprenticeship Committees was followed closely in ASCO.

Another factor which influenced the final structure of the classification was the design objective of producing a structure which is statistically balanced. For example, since there are eight major groups in the classification, the average size of a major group is 12.5 percent of the labour force. A group which is smaller than 5 percent of the labour force is not considered as a 'major' group. In practice, the approximate size of the major groups ranges from 5.5 percent to 18 percent. A similar design constraint was imposed at all levels of the classification. In addition, a somewhat arbitrary limit of 300 was set as the minimum number of jobs in an occupation before it was given the status as such in ASCO. Groups of jobs smaller than this are given the status of specialisations of occupations, for which no statistics are separately produced.

The classification has also been modified to take account of limitations imposed by data collection possibilities in statistical censuses and surveys. An extensive program of operational testing conducted by the ABS to ensure the statistical feasibility of categories defined at all levels of the structure had led to modifications of the draft classifications. In general, distinctions between categories which proved difficult to draw on the basis of available data were relegated to the lower levels of the classification, for example, apprentices and tradespersons, supervisors and supervisees, which would require a number of extra questions be asked for correct classification of the data.

Lastly, the classification had to be developed in such a way that its major and minor groups have intuitive appeal and some minimum level of comparability with other major national and international occupation classifications. A number of early prototype structures developed on the basis of a more strict application of the ASCO criteria were rejected on this basis.

International Comparability

When it was first published in 1986, ASCO was significantly different from most other occupation classifications used by national and international statistical agencies and labour departments. This was most evident in its classification of jobs performed by manual workers and in the creation of a new major group, para-professionals, covering some jobs performed by nonmanual workers.

ISCO-88 published by the International Labour Office has been developed using a similar conceptual approach to that developed for ASCO and has four levels without the occupation level in ASCO. The 10 major groups in ISCO-88 closely resemble the eight ASCO major groups. The most significant difference at major group level is that ISCO-88 has identified skilled agricultural and fishery workers as a separate major group, whereas ASCO includes most of these occupations as a minor group in its major group, managers and administrators. ISCO-88 also has a broader definition of the major group, technicians and associate professionals, than that used in the ASCO major group, para-professionals. Also ISCO-88 includes some of the more skilled occupations found in the two ASCO major groups, clerks, salespersons, and personal service workers, in technicians and associate professionals.

ISCO-88 has a separate major group, Armed Forces. In ASCO, jobs held by members of the armed services are classified together with their civilian equivalents where these exist and to a number of specific unit groups otherwise.

At the unit group level, the differences between ASCO and ISCO-88 are quite marked as ISCO-88 has retained some measure of comparability with ISCO-68.

Structured Coding System

Most of the principal applications of ASCO require a tool for the coding of information about a particular job to the classification in an accurate, consistent and efficient manner. The adoption of classification criteria based on the skills required to perform the tasks necessitates quality and comprehensive data for accurate ASCO coding. As the result of an extensive program of feasibility testing, it was found that data on occupation tasks as well as the occupation title were needed.

Accordingly, the development of the classification was accompanied by the development of a structured coding system, described in the ASCO Manual Coding System: Unit Group Level (ABS Catalogue number 1225.0). This system enables occupation responses to be coded to the

unit group level of the classification with a high degree of accuracy and consistency. It is designed to utilize, in a systematic way, the responses from up to four distinct questions: Occupation title, main tasks performed, kind of industry description, and employer's name. The use of these responses is controlled by the assignment of different status levels to information from each item. Primary importance is given to the occupation title but extensive use is made of main tasks performed in the job; restricted use can also be made of information given in response to questions on kind of industry and employer's name.

Although it provides accurate and consistent coding, the manual coding system is complicated and results in a much slower coding operation than was typical with the various occupation classifications used previously. Hence, the manual implementation of the ASCO Coding System requires extensive coder training and is expensive.

Computer Assisted Coding

To reduce the costs of coding in large scale statistical collections while preserving the gains in data quality obtained by structured coding, a computer-assisted version of the system was developed.

The computer assisted coding system combines the coder's ability to interpret occupation title and task responses with the fast searching and matching abilities of a microcomputer. The system was conceived as a stand-alone individual coder productivity tool running on IBM XT, AT, or PS/2 compatible microcomputers. It was initially designed to facilitate the coding of 6.5 million occupation responses to ASCO in the 1986 Census of Population and Housing, where it achieved significantly higher coding rates than would have been obtained using the manual system.

Since then the system has been rewritten with enhanced functionality and efficiency for release as the ASCO Expert Coding System: Unit Group Level (ABS Catalogue number 1224.0) and the ASCO Expert Coding System: Occupation Level (ABS Catalogue number 1226.0).

The principal features of the system include:

- Minimisation of key entry of data;
- Fast and efficient searching;
- Carefully designed matching rules to determine the range and order of choices presented to the coder;
- Ability to code a wider range of occupation responses as a result of the progressive relaxation of matching rules when necessary to obtain a code;
- Faster coding rates achieved by the presentation of choices on the screen in such a way as to allow fast assimilation of information and fast reaction by the coder;
- Improved data quality as a result of greater control over the implementation of coding rules; and
- Faster resolution of queries by the provision of on-line access to the classification structure and all the definitional material in the classification.

ASCO Expert is designed to assign the same codes as the Manual Coding System and uses the same coding index. In practice, however, results obtained using ASCO Expert tend to be more consistent and more accurate than those obtained using the manual system; the query rate (the incidence of cases where the coder cannot assign a code using the standard procedures) also tends to be lower.

Need for a second edition of ASCO

The first edition of ASCO was intended to serve for the 10 years 1986 to 1995. As it comes to the end of its intended life, ASCO is becoming out of date because of the changes and developments in occupations brought about by widespread industry restructuring and changes to industrial awards. The introduction of competency-based approaches to training also renders the definitions of skill level in the occupations out of date.

As for the development of the first edition of ASCO, a joint steering committee and a working group involving officers from the ABS and Department of Employment, Education and Training (DEET) were set up in mid-1992 to review the first edition of ASCO. In view of the close economic relations with New Zealand (NZ) and the understanding reached between Australia and New Zealand regarding statistical harmonization, it has been agreed that the NZ Department of Statistics will also take part in the review.

Term of reference for the Review are as follows:

- Provide a framework for analysing Australia's occupational labour market over the 10 years from 1996 to 2005;
- Take account of major new developments across employment, education, and training, particularly award restructuring and competency-based approaches to career entry and progression (as distinct from approaches based on time served or qualifications gained);
- Take account of change and development within particular occupations, for example, because of technological changes and industry restructuring;
- Produce quality statistics which can be compared with those from the ASCO First Edition and the International Standard Classification of Occupations (ISCO); and
- Develop a classification maintenance program, so that less work should be involved in the movement towards a third edition for the Census of 2006.

It is intended that the new edition of ASCO will be developed in time for use in the 1996 Census. To the extent that the ABS and DEET are still appreciating the implications for ASCO of the industrial, vocational education and training developments, and that the Review

is still in its early stage, the discussions that follow are inevitably general. These discussions are based principally from the conclusions of a consultancy report prepared by David Rumsey (1993) for DEET.

Industrial Developments

The current Australian workplace and training reforms are part of a package to free up the economy, including the reduction of trade tariff, deregulation of financial markets, and tax and microeconomic reforms. A principal objective of the workplace, vocational education, and training reforms is, through the adoption of international best practice, to improve the international competitiveness of Australia's products and services.

Since 1983, the restructuring of Australian industry has been significantly influenced by a series of "accords" between the Commonwealth Government elected in that year and the Australian Council of Trade Unions. These Accords have been a key part of the Government's submissions of successive National Wage Cases to the Australian Industrial Relations Commission (AIRC). The overall thrust of the National Wage Cases has consistently been the need for workplace reform.

Award restructuring has been a key element of each successive national wage case since 1987. While the overall thrust has been to increase productivity and international competitiveness, the various components which have implications on ASCO include:

- The establishment of new forms of work organisation and the development of a multi-skilled, adaptable workforce;
- The simplification of awards by reducing the number of classifications and broadbanding jobs;
- Suitable changes to job titles where appropriate;
- The provision of classifications which encourage horizontal and vertical mobility within firms, allow for a broader range of functions and responsibilities, and minimise lines of demarcation;
- The establishment of career paths which involve successively higher levels of skill, responsibility and pay involving training incentives, wider career opportunities, and higher levels of flexibility and productivity;
- The provision of definitions of award classifications which clearly establish the range of work required and the level of expertise to be achieved through training;
- The provision of competency standards and appropriate certification and accreditation arrangements; and
- The establishment of links between training, competence and wages which results in a career path to enable a worker under an award to have the opportunity to progress to the highest paid job classification.

As an example to illustrate the impact of award restructuring in industries, the previous total of 340 highly specialised classifications in the metals and engineering industry is now replaced by some 14 broadbanded classifications. As a result, most of the occupations in the three ASCO minor groups, metal fitting and machining tradespersons, other metal tradespersons, and electrical and electronics tradespersons are now covered by the award of Engineering Tradespersons under the three streams "mechanical," "fabrication," and "electrical/electronic".

One of the more significant trends in the on-going evolution of award restructuring is the move towards increasing decentralisation of the industrial relations system to the industry and enterprise level. This is providing growing scope for enterprise bargaining and an increasing diversity in the nature of enterprise and industrial agreements. To exemplify, the Australian Public Service Act is reported to be substantially rewritten over the next 12 months with the intention of encompassing agency-level enterprise bargaining as well as many of the management changes introduced in the last decade. The trend appears to be shifting tasks and functions of occupations towards a need for broader and more general skills. Interpersonal, analytical, communication, and organising skills would appear to be becoming increasingly important in this context. These skills are general skills that are likely to be shared across many, if not all, occupations. It is expected that the effect of workplace bargaining will be a proliferation of enterprise specific occupation titles with responsibilities that may or may not vary across enterprises.

Appendix C gives the definitions of the more commonly used terms in the Australian industrial relations arena.

Vocational Education and Training Developments

Vocational education and training developments over the past 10 years have included special efforts to ensure that they are linked to the concurrent industry reform. These developments impact in various ways on ASCO because of their effect on qualifications, their focus on the development of workplace competence and their role in facilitating the career pathways required within new industrial award structures. The following is a summary of the main initiatives.

Competency-based training

The system of competency-based vocational education and training currently being developed in Australia is a product of award structuring and the various workplace reforms initiated over the past 6 years. This system involves the delivery, assessment and certification of training needed to attain the necessary knowledge, skills and their application required for effective performance in the relevant industrial award classifications. The performance requirements of workers for specific industrial award

classifications are detailed in industry-defined national competency standards.

Competency-Based Training (CBT) is defined as:

"Training concerned with the attainment and demonstration of specified skills, knowledge and their application to meet industry standards rather than with an individual's achievement relative to that of others in a group. In other words, it is 'criterion referenced' rather than 'norm-referenced,'" (National Training Board, 1992).

"Competency-based training includes the recognition of 'prior learning' or the competencies a trainee already has, regardless of where or how these competencies were acquired. This means that trainees do not have to repeat the training associated with achieving these competencies (saving training effort and resources)," (Employment and Skill Formation Council, 1992).

The implications of developments in competency-based training and the related national competency standards for ASCO will be to change the operational definition of skill level which will have to be defined in terms of competencies rather than, in the main, qualifications.

Entry-level training

A new system of entry-level training for Australia, which is focused around a system of four qualifications—Australian Vocational Certificates (AVC's), Levels 1 to 4—is being proposed by the Employment and Skills Formation Council for 1995. The new system of entry level training is intended to replace the current systems of apprenticeships and traineeships and will be competency based. The new system, which has to be reflected in ASCO, is to provide the first rung on a set of career pathways in which workers will be able to develop their skills through a variety of training opportunities both on-the-job and off-the-job.

Pathways between training and work

The new system of vocational education and training intends to offer a broad range of "pathways" involving combinations of education, training and work experience that may lead to a qualification, another training pathway or a career step. The pathways include services offered by various providers—schools, Technical and Further Education colleges, industry, and other private providers—and will take account of the many and varied ways people become competent for work. Therefore, in the next edition of ASCO, qualification—being one of the three operational definitions of skill level—has to be defined in such a way that it can be obtained through the above pathways.

Career paths

Central to both the award restructuring process and the changes to vocational education and training is the requirement for both occupations and training programs to be linked across a system of career structures. Within specific industries, arrangements are being put in place which facilitate opportunities for logical progression either horizontally into related occupations or vertically into higher level occupations. Industrial awards are being structured to prevent barriers to such mobility. Training options are being structured to assist workers to either develop the necessary competencies to take advantage of these opportunities or to have existing competencies recognized through new arrangements for the recognition of competence. Therefore, the grouping of occupations in the second edition of ASCO has to provide flexibility to allow for occupational analysis by career paths.

Implications for the Structure and Content of ASCO Second Edition

The major implications of industry, vocational education, and training reforms for the structure and content of ASCO Second Edition appear to be as follows:

- The realisation of most of the industry, education and training reform initiatives in the workplace and classrooms will extend over a long period, probably well beyond the year 2000. While the changes and their impact are expected to be significant, the timing of the changes will be drawn out and will vary from industry to industry. ASCO will need to be able to accommodate the progressive implementation of the reform. To the extent that the structure of occupations is constantly changing, ASCO should be continuously updated and maintained.
- The current emphasis in both industrial, vocational education and training reforms towards career path structures implies the need for ASCO to be able to be used to statistically monitor the flow and distribution of workers along the career paths within industries and/or functional areas.
- The broadbanding of occupations within the award restructuring process will reduce the number of separate ASCO occupations considerably.
- The current thrust towards enterprise bargaining will yield local variations in both tasks and titles which have to be accommodated in ASCO. However, it is anticipated that the general thrust and spirit of the national awards and associated competency standards will be maintained in these occupations.
- The combined effects of the broadbanding of occupations and enterprise bargaining imply that the previous close linkage between occupational titles and the associated set of tasks may no longer be valid. In other words, occupational titles are becoming less and less a reliable indicator of how a job should be classified. In the future greater emphasis will need to be placed on "tasks" rather than "titles" in the interpretation and coding of jobs data against ASCO.

• The current vocational education and training reforms are intended to bring training in line with industry reform. The current emphasis on competency-based training and recognition and flexible career pathways involving both on-the-job and off-the-job learning, and the recognition of competence, however achieved, implies the need for ASCO to modify the way skill level is to be defined in the future. Rather than defining skill level in terms of duration of training and previous experience, it should preferably be defined in terms of competency.

These major implications are further articulated as follows:

Relevancy of the concept of occupations

It is clear that the concept of occupations as defined in ASCO is still relevant for the next edition. However, in the current climate of change, the definitions of occupations are rapidly changing, and new occupations are periodically formed. This implies that these definitions have to be continually reviewed and updated, and that new occupations are identified and included in ASCO.

Skill level and skill specialisation

The use of skill level and skill specialisation as criteria for classifying occupations will continue to be relevant. In light of the developments in competency standards and competency-based training, skill level should be operationally defined in terms of competencies.

Definitions of occupations in competency-based terms

As various occupations become defined in competency-based terms within new industrial awards or enterprise agreements, occupational definitions in ASCO will need to be suitably modified to reflect this competency basis of occupations. On the other hand, as the universities and the professions have yet to adopt the formalised competency-based approach along the lines of the National Training Board, ASCO must be robust enough to accommodate occupations that have competency-based definitions and those that do not. Complications are likely to arise where occupations are shared across industries, some of which have adopted the competency-based approach and others that have not.

However, the present rate of progress suggests that it may be a long time before the majority of occupations are defined in competency-based terms. It will probably be even longer before workers are fully familiar with their new job titles and the competency standards that will in the future define their job role and functions. The next edition of ASCO will need to be able to accommodate the progressive yet long term nature of these changes.

Tracking of broadbanded and new occupations

Broadbanding will result in new combinations of skills for new occupations and also creation of new occupational titles. Their emergence has to be regularly monitored and ASCO regularly maintained. As well as reforms occurring in "traditional" industries, new and evolving industries also generate new occupations not previously catered for in ASCO. Examples of these are the rapidly growing Information Technology and the Environmental Protection Industries.

Increasing diversity of occupations

It is likely that enterprise bargaining will bring about an increasing diversity of occupations. However, the duties associated with these occupations will be more formally linked to competency standards. These occupations may have identical titles although their duties are different. Conversely identical occupations may have different titles. This raises a major issue for ASCO coding which, in the first edition, relies heavily on title responses.

Flexible structure

With increased flexibility in pathways and cross industry career progression, there will be increased incidence of workers who move horizontally across different occupations as a career progression, as well as upwards within a particular major group stream. The new structure of ASCO must be flexible enough to allow for career path analysis of the data.

Likely Changes to ASCO

Clearly the next edition of ASCO has to address all the implications as outlined in the preceding discussions. As the current version of ASCO is progressively reviewed, specific changes to ASCO will be drawn up. The joint project team is currently considering some of the recommended changes which are outlined under the following broad headings.

Procedures for Monitoring the developments affecting ASCO

It will be essential to establish appropriate procedures to monitor developments in industry, vocational education and training with a view to continually updating ASCO. These include, in particular, monitoring of broadbanding of occupations, and emergence of new occupations arising from enterprise bargaining, technological change and new industries. The procedures would necessitate establishing a network of contacts with the industry, employer, union and education bodies to ensure an ongoing program of monitoring is undertaken on an industry by industry basis, and particularly at the enterprise level.

Use of competency as indicator of skill level

The use of qualifications and duration of training and experience as an indicator of skill level will become less and less relevant in light of the current vocational,

education and training reforms. As the future system of credentials will be more competency-based and include recognition of competence gained through work experience and on-the-job training, competency will become more important as indicator of skill level in ASCO. This necessitates major revisions of existing ASCO definitional material.

Increasing use of tasks rather than titles in coding

Given the effects of broadbanding and changes at the enterprise level, titles will become an increasingly unreliable indicator for classifying occupations, which has major implications for the coding of occupational responses to ASCO. This will also call for the need to re-consider the design of the questions required to collect data on titles and tasks, in order to place more emphasis on the latter during data collection.

Major group structures

Consideration will be given to modifications to the major group structure of ASCO to meet existing user problems including the need for career path analysis. As well, other complementary major group structures may be developed to cater for other types of use of ASCO, for example, vocational guidance and socio-economic status analysis.

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Appendix A. Glossary of Terms

The Accord

The Accord in its various forms (Mark I—Mark VI) is the abbreviated term for the Prices and Incomes Accord between the Australian Government and the Australian Council of Trade Unions. This establishes a framework for economic management, particularly in relation to wage fixation and the process of award restructuring.

The Australian Industrial Relations Commission (AIRC)

The AIRC is the industrial tribunal established under the Industrial Relations Act 1988 in order "to provide a framework for the prevention and settlement of industrial disputes by conciliation and arbitration. . . ." The AIRC came into operation on 1 March 1989 and replaced the former Australian Conciliation and Arbitration Commission.

Award

An award is the instrument by which an industrial tribunal prescribes the terms and conditions under which a particular category of people are employed. Awards would normally cover such issues as classification, pay rates, working hours, penalty rates and overtime provisions and holiday leave. Awards are legally binding on the parties respondent to them.

Award restructuring

Award restructuring is the process whereby employers and relevant unions cooperate to undertake a fundamental review of an existing award(s).

The restructuring process has as major priorities the revision of job classification structures, multi-skilling and the provision of new career paths, underpinned by major reforms to skill formation and training arrangements.

National wage case

The term National Wage Case (NWC) refers to the hearing or case conducted before a Full Bench of the Federal industrial tribunal (now the Australian Industrial Relations Commission) in order to determine a national wage standard for the Australian workforce as a whole.

National Wage Cases and the associated concept of National Wage Case principles handed down by the Commission began from September 1983 when there was a return to a centralised wage fixation system in Australia.

Productivity bargaining

Productivity bargaining is the process where employers and employees negotiate with the aim of increasing productivity in return for higher levels of pay and/or conditions. Workers may agree to changes in work practices, the elimination of restrictive practices etc. in return for material benefits.

Workplace bargaining

A process of productivity bargaining, including appropriate gainsharing arrangements, conducted at an enterprise level. The Industrial Relations Act contains specific new provisions to facilitate certification of enterprise or workplace bargaining agreements.

Source: Glossary of Industrial Relations Terms produced by the Australian Industrial Relations Commission (AIRC)

Appendix B. ASCO Structure—Major, Minor, and Unit Groups

1 Managers and Administrators

11 Legislators and government appointed officials
1101 Parliamentarians, councillors and government representatives
1103 Judges, magistrates and mediators

12 General managers
1201 General managers

13 Specialist managers
1301 Finance managers
1303 Sales and marketing managers
1305 Production managers
1307 Supply and distribution managers
1309 Personnel and industrial relations managers
1311 Data processing managers
1313 Public policy managers
1315 Directors of nursing
1317 Education managers
1319 Commissioned officers (management)
1399 Other specialist managers

14 Farmers and farm managers
1401 Farmers and farm managers

15 Managing supervisors (sales and service)
1501 Shop managers
1503 Restaurant and catering managing supervisors
1505 Accommodation and tavern managing supervisors
1507 Financial institution branch managers
1599 Other managing supervisors (sales and service)

16 Managing supervisors (other business)
1601 Managing supervisors (other business)

2 Professionals

21 Natural scientists
2101 Chemists
2103 Geologists and geophysicists
2105 Physicists
2107 Life scientists
2109 Medical testing professionals
2199 Other natural scientists

22 Building professionals and engineers
2201 Architects and landscape architects
2203 Quantity surveyors
2205 Cartographers and surveyors
2207 Chemical engineers
2209 Civil engineers
2211 Electrical and electronics engineers
2213 Mechanical engineers
2215 Mining engineers
2217 Metallurgists and material scientists
2219 Other engineers

23 Health diagnosis and treatment practitioners
2301 General medical practitioners
2303 Specialist medical practitioners
2305 Dental practitioners
2307 Pharmacists
2309 Occupational therapists
2311 Optometrists
2313 Physiotherapists
2315 Speech pathologists
2317 Chiropractors and osteopaths
2319 Podiatrists
2321 Radiographers
2323 Veterinarians
2399 Other health diagnosis and treatment practitioners

24 School teachers
2401 Pre-primary school teachers
2403 Primary school teachers
2405 Secondary school teachers
2407 Special education teachers

25 Other teachers and instructors
2501 University and CAE teachers
2503 TAFE teachers
2505 Extra-systemic teachers and instructors

26 Social professionals
2601 Social workers
2603 Counsellors
2605 Lawyers
2607 Ministers of religion

27 Business professionals
2701 Accountants
2703 Public relations officers
2705 Personnel specialists
2707 Computing professionals
2799 Other business professionals

28 Artists and related professionals
2801 Painters, sculptors and related professionals
2803 Photographers
2805 Designers and illustrators
2807 Journalists

2809 Authors and related professionals
2811 Film, television and stage directors
2813 Dancers and choreographers
2815 Musicians, composers and related professionals
2817 Actors and related professionals
2819 Announcers

29 Miscellaneous professionals
2901 Economists
2903 Psychologists
2905 Education researchers and related professionals
2907 Other social scientists
2909 Mathematicians, statisticians and actuaries
2911 Librarians
2999 Other professionals

3 Para-Professionals

31 Medical and science technical officers and technicians
3101 Medical technical officers and technicians
3103 Science technical officers and technicians

32 Engineering building associates and technicians
3201 Electrical and electronic engineering associates and technicians
3203 Civil engineering associates and technicians
3205 Mechanical engineering associates and technicians
3207 Building, architectural and surveying associates and technicians
3299 Other engineering and building associates and technicians

33 Air and sea transport technical workers
3301 Aircraft pilots
3303 Air transport operating support workers
3305 Ship's pilots and deck officers
3307 Marine engineers and surveyors

34 Registered nurses
3401 Registered nurses

35 Police
3501 Police

39 Miscellaneous para-professionals
3901 Welfare para-professionals
3903 Performing arts support workers
3905 Inspectors and regulatory officers
3907 Child care coordinators
3909 Ambulance officers
3911 Prison officers
3913 Procurement officers
3915 Sportspersons and related workers
3999 Other para-professionals

4 Tradespersons

41 Metal fitting and machining tradespersons
4101 Toolmakers
4103 Metal fitters and machinists

42 Other metal tradespersons
4201 Forging tradespersons
4203 Sheetmetal tradespersons
4205 Structural steel, boilermaking and welding tradespersons
4207 Metal casting tradespersons
4209 Metal finishing tradespersons
4211 Aircraft maintenance engineers
4213 Precision metal tradespersons

43 Electrical and electronics tradespersons
4301 Electrical powerline tradespersons
4303 Electrical fitters
4305 Automotive electricians
4307 Refrigeration and air-conditioning mechanics
4309 Electrical mechanics
4311 Communications equipment tradespersons
4313 Radio and television servicers
4315 Office equipment and computer servicers
4399 Other electrical and electronics tradespersons

44 Building tradespersons
4401 Carpenters and joiners
4403 Bricklayers
4405 Painters, decorators and signwriters
4407 Plasterers
4409 Plumbers
4411 Roof slaters and tilers
4413 Wall and floor tilers

45 Printing tradespersons
4501 Compositors
4503 Graphic reproduction tradespersons
4505 Printing machinists
4507 Binders and finishers
4509 Stereotypers and electrotypers
4511 Screen printers

46 Vehicle tradespersons
4601 Vehicle mechanics
4603 Panel beaters
4605 Vehicle painters
4607 Vehicle body makers
4609 Vehicle trimmers

47 Food tradespersons
4701 Meat tradespersons
4703 Bakers and pastrycooks
4705 Cooks
4799 Other food tradespersons

48 Amenity horticultural tradespersons
4801 Nurserymen/women
4803 Greenkeepers
4805 Gardeners

49 Miscellaneous tradespersons
4901 Wood machinists and turners
4903 Cabinetmakers
4905 Other wood tradespersons
4907 Marine construction tradespersons

4909 Blasting tradespersons
4911 Garment tradespersons
4913 Upholsterers and bedding tradespersons
4915 Shoemaking and repairing tradespersons
4917 Other leather and canvas tradespersons
4919 Floor coverers
4921 Glass tradespersons
4923 Jewellery and precious metalware tradespersons
4925 Craftworkers
4927 Hairdressers
4929 Sheep shearers
4931 Animal trainers
4999 Other tradespersons

5 Clerks

51 Stenographers and typists
5101 Office secretaries and stenographers
5103 Typists and typist-clerks
5105 Word processing operators

52 Data processing and business machine operators
5201 Data processing machine operators
5203 Business machine operators

53 Numerical clerks
5301 Accounting clerks
5303 Insurance and broking clerks
5305 Statistical and actuarial clerks

54 Filing, sorting, and copying clerks
5401 Library and filing clerks
5403 Mail sorters
5499 Other filing, sorting and copying clerks

55 Material recording and dispatching clerks
5501 Production recording clerks
5503 Transport recording and dispatching clerks
5505 Stock and purchasing clerks

56 Receptionists, telephonists, and messengers
5601 Receptionists and information clerks
5603 Telephonists
5605 Messengers and delivery officers

59 Miscellaneous clerks
5901 Collection clerks
5903 Teachers' aides
5905 Personnel clerks
5907 Legal and related clerks
5909 Postal Clerks and officers
5999 Other clerks

6 Salespersons and Personal Service Workers

61 Investment, insurance, and real estate salepersons
6101 Securities and finance dealers
6103 Insurance brokers and agents
6105 Real estate salespersons and property managers
6199 Other investment, insurance and real estate salespersons

62 Sales representatives
6201 Sales representatives

63 Sales assistants
6301 Sales assistants

64 Tellers, cashiers, and ticket salespersons
6401 Tellers
6403 Cashiers
6405 Ticket salespersons

65 Miscellaneous salespersons
6501 Street vendors, canvassers and sales drivers
6503 Bar attendants
6505 Waiters and waitresses
6507 Travel agents
6599 Other salespersons

66 Personal service workers
6601 Child care, refuge and related workers
6603 Enrolled nurses
6605 Dental nurses
6607 Home companions and aides
6609 Travel stewards
6699 Other personal service workers

7 Plant and Machine Operators, and Drivers

71 Road and rail transport drivers
7101 Bus and tram drivers
7103 Automobile drivers
7105 Truck drivers
7107 Locomotive drivers

72 Mobile plant operators (except transport)
7201 Excavating and earthmoving plant operators
7203 Forklift and related drivers
7205 Logging plant operators
7207 Paving and surfacing plant operators
7209 Agricultural plant operators
7211 Firefighters
7299 Other mobile plant operators (except transport)

73 Stationary plant operators
7301 Power generation plant operators
7303 Engine and boiler operators (except power generation)
7305 Chemical plant operators
7307 Petroleum and gas plant operators
7309 Bulk materials handling plant operators
7311 Crane operators
7313 Hoist, winch and lift operators
7315 Furnace and kiln operators
7317 Drilling plant operators
7399 Other stationary plant operators

74 Machine operators
7401 Basic metal products machine operators
7403 Metal press operators
7405 Other metal products machine operators
7407 Plastics production machine operators
7409 Rubber production machine operators
7411 Chemical production machine operators

7413 Wood processing machine operators
7415 Paper and paper products machine operators
7417 Glass production machine operators
7419 Clay and stone processing machine operators
7421 Yarn production machine operators
7423 Hide and skin processing machine operators
7425 Fabric production machine operators
7427 Textile sewing machinists
7429 Shoemaking machine operators
7431 Food processing machine operators
7433 Packaging machine operators
7435 Photographic products machine operators
7499 Other machine operators

8 Labourers and Related Workers

81 Trades assistants and factory hands
8101 Trades assistants
8103 Assemblers
8105 Hand packers
8107 Industrial spray painters
8109 Quality controllers
8199 Other trades assistants and factory hands

82 Agricultural labourers and related workers
8201 Farm hands and assistants
8203 Forestry labourers
8205 Nursery and garden labourers
8299 Other agricultural labourers and related workers

83 Cleaners
8301 Cleaners

84 Construction and mining labourers
8401 Installation workers
8403 Concrete workers
8405 Structural steel and related construction labourers
8407 Earthmoving labourers
8409 Paving and surfacing labourers
8411 Survey hands
8413 Railway labourers
8415 Mining and mineral ore treating labourers
8499 Other construction and mining labourers

89 Miscellaneous and related workers
8901 Ushers and door attendants
8903 Luggage porters
8905 Garbage collectors
8907 Storemen/women
8909 Freight and furniture handlers
8911 Guards and security officers
8913 Caretakers
8915 Housekeepers
8917 Laundry workers
8919 Kitchenhands
8921 Ward helpers
8923 Vehicle accessories fitters
8925 Fishermen/women, deckhands and seamen/women
8999 Other labourers and related workers

Appendix C. Uses of ASCO

Human resource management

• Extensive use of ASCO is incorporated into personnel record systems for regular reporting as required by Affirmative Action and state Equal Employment Opportunity Acts.

• ASCO is incorporated into Personnel Information Management System (PIMS) developed by the Public Service Board of WA.

• ASCO is used by private consulting firms in job classification and personnel systems development.

Occupational health and safety

• ASCO is adopted by the National Occupational Health and Safety Commission (Worksafe Australia) for use in the National Data Set for compensation-based statistics.

• ASCO is used for coding occupations in studies of exposure to risk of accident conducted by the National Injury Surveillance Unit of the Australian Institute of Health and Welfare.

Workers' compensation

• ASCO is required for coding occupations on workers' compensation claims reported to Workcover Authorities in various States and to Comcare.

• ASCO codes are incorporated into computer-based report modules developed by a private company for clients presenting compensation data to Comcare or Workcover.

• ASCO codes are used in rehabilitation reports on claimants for workers' compensation.

Immigration

• ASCO is adopted by Department of Immigration and Ethnic Affairs (DIEA) as the standard for coding occupation from passenger cards for long-term arrivals/departures.

• ASCO is used by DIEA for classifying usual occupation of applicants for migration.

• ASCO is used by private sector migration consultants in preparing applications.

National training reform

• As the standard classification system for occupations in the Australian labour market, ASCO is used extensively by CSBs and ITABs and associated organisations to identify occupations to be covered by different industry standards bodies.

Technical and further education (TAFE)

• ASCO is used to code expected occupational outcome for TAFE courses by State authorities reporting to National Centre for Vocational Education Research Ltd.

• ASCO unit group code is specified as Occupation Type Identifier in draft data model for the National Management Information and Statistics Systems project.

Social research

• ASCO is used to code responses to occupational questions in surveys undertaken by the Australian National University, Australian Council for Educational Research, Australian Institute of Family Studies and National Heart Foundation.

• ASCO is used to code occupations in epidemiological studies at Queensland Institute of Medical Research (twin study), Dept of Public Health University of WA, Medical Faculty University of Newcastle (MONICA project).

• As specified by clients ASCO is used to code occupations in surveys undertaken by commercial research organisations.

Some Issues Related to Occupational Classifications

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This paper focusses on two issues: the principles of an occupational classification structure and the applicability of International Standard Classification of Occupations (ISCO) as a model. These issues are illustrated with examples from France and from several North African countries.

Principles of an occupational classification structure

There are at least three major objectives that occupational classifications are expected to meet:

- The most obvious one is to serve as a basis for the population census and for statistical surveys undertaken by statistical offices. The main concern here is for a social and demographic approach, and for an instrument which facilitates the identification of meaningful and coherent social groups.
- More specifically, but equally important, is the need for an operational tool at the disposal of employment services for recording and matching job vacancies and workers. Here, the concern is more for a concrete understanding of the job that people are performing and of the functioning of the labor market.
- Somewhat related to this is the interest for classifying the active population in terms of the skills and the level of competence that people are supposed to master or which are required to fill a job. It is often hoped that this might provide an approach for estimating skill requirements and help in the planning of education and training.

There may also be a concern for the classification of workers, within an enterprise or an industry, for the purposes of wage determination. But this is definitely a different approach.

Having recognized the variety of objectives pursued and the concerns with regard to occupational classifications, the question arises whether it is possible to satisfy all of them with a single system. From the methodological point of view, the best solution would probably consist of a common basic system with different variations meeting more specific purposes, or to conceive different systems between which data can be automatically transferred. Some concrete illustrations of these problems will be discussed in the next part of this paper.

Jobs and classifications are multi-dimensional notions and can therefore be described in a variety of ways, combining different criteria. There is no fully satisfactory solution to this difficult problem. It usually requires compromises. Nevertheless, it is desirable to start from a clear definition of concepts and from explicit choices of priorities. They are normally related to the respective priority attached to the above-mentioned objectives.

Comparability and conversion of data can be difficult or even impossible when classifications are based on a single structure with different concepts. An alternative approach might be to attempt to identify occupations by a combination of several classification and coding systems referring to different criteria. One could think, for instance, of different codes to define social status and position. Combining this type of information could make possible a rather precise identification of the worker, on the basis of relatively simple codes, and could facilitate the comparisons between classification systems within a country or between countries.

Applicability of ISCO as a model

If it is agreed that there is no perfect system of occupational classification and that it is difficult to meet different objectives with one system, we have to accept limitations in the applicability of ISCO to different national contexts. At least two types of difficulties can be mentioned here.

1) The first difficulty would be the differentiation between major groups by levels of competence. Many occupational classifications attempt to define large groups on the basis of a difference between levels. However, it is always a problem to identify and to apply proper criteria facilitating this differentiation, particularly with regard to managerial, administrative, and commercial occupations. The criterion used by ISCO is the level of competence. Competency is in itself a rather loose concept. It is interpreted here in terms of the level of educational attainment required to fill a job, which in a way is more precise. However, (as mentioned above) the problem is that educational require-

ments may vary greatly, according to time and location, in relation to the supply of educated people. Therefore, the criterion may be valid within a specific context, but comparisons between countries and over time may be questionable.

Another interpretation of the notion of level of competence might be the reference to the status, for instance, as classified in a collective agreement. This may be more meaningful within a given country, but problems are likely to occur for comparisons between countries with different institutional and social contexts (for instance the word "manager" may have different meanings in various countries and does not quite correspond to a "cadre" in the French system).

In practical terms, these difficulties are likely to occur with regard to managerial occupations and public service occupations. There may be a temptation to classify as corporate managers and general managers people working in very small firms. The additional information required in public service as well as in the private sector is not always available.

2) Whereas the first type of difficulty is rather common with classification systems and difficult to avoid, the second type, as we see it, is rather specific to ISCO. It derives from the distinction between major groups 7 and 8. It is not very clear whether the distinction refers to the work process (distinction between traditional crafts and industrial production), the utilization of machines, or the level of competence.

The third difficulty, not suggested by the introductory comments, is that most occupations in both groups belong to level 2. The use of machines does not seem to be a factor in differentiating between occupations such as machine-tool setters and setter-operators (7223) and machine-tool operators (8211). In this example, the work process criterion is not applicable either; in modern production, a variety of workers of this type can be found together in the same workshop and are very difficult to differentiate.

Another problem area concerns the printing occupations, which are scattered between the major groups, while workers in these occupations are often grouped together with little differentiation within small firms.

Some of these problems may be illustrated by examples from France and two North African countries.

The French example

The French example is interesting in view of its rich experience of a variety of classification systems, which required a considerable amount of investment. This experience has to be seen in a historical perspective.

After World War II, collective agreements in the various industries included a classification of some 30,000 jobs in terms of skills and of wages. This was the basis for the construction of the first classification of occupations used for the 1954 and 1975 censuses, with a decreasing number of items (1,130 and 284 for coding, 670 and 188 for publication). A revised version was published in 1967, to serve as a basis for more specific employment surveys.

In the meantime, the planning process required the use of more aggregated classifications. A different system had also been conceived in 1954 in order to identify broad and homogeneous social groups (catégories socio-professionnelles, or CSP), taking into account new criteria such as skill and educational level.

In the 1970's, it was realized that the system was exceedingly complex, and that, at the same time, there was a shortage of adequate qualitative information on job content. This is why three different institutions in charge of youth orientation, placement, and studies on the education-training-employment relationship (CEREQ) undertook, at almost the same time, thorough field investigations (with an obvious lack of coordination). One of the objectives assigned to the third undertaking (the "Répertoire des emplois") was definitely to serve as a more concrete and systematic basis for an entirely new classification.

This was the responsibility of the Statistical Institute (INSEE) through a long process, involving lengthy discussions with experts from the other institutions and then with social partners. The new classification was a combination of systematic principles and of a more pragmatic approach at the final adjustment stage. The principles are the following:

- To adopt a single system which should be substituted for the previous ones;
- To fully integrate the classification of social groups within the new system, referred to as the "Classification des professions et catégories socioprofessionnelles" (Occupational and socio-occupational groups). The idea is to emphasize the social image of occupations. It is indeed the criterion for the construction of the major groups, such as independent workers, civil servants, managers, and so on;
- To structure the classification around two types of additional criteria: one concerning the position within the firm (particularly taking function into account) and job content; the other is related to the skill and educational qualifications required to fill a job.

This classification, used for the first time in 1982, includes 489 items, with different levels of aggregation. Since then, it has been used for all kinds of occupational surveys and analyses.

In the late 1980's, however, the employment agency ("Agence nationale pour l'emploi", or ANPE) undertook the revision of its dictionary of occupations (Répertoire opérationnel des métiers et emplois, or ROME) with a

completely new approach. The earlier version, recorded job vacancies, included more than 1,000 definitions of occupations, defined in a traditional way with reference to usual designations and classified basically in terms of industry. The new version was conceived (with the assistance of a CEREQ expert and using the experience of the "Répertoire des emplois," implying better coordination) as a tool to record vacancies, and also to provide information on occupations for placement and to help in the guidance process. The final document should be published shortly and the corresponding data processing system should then be put into operation.

This concept led to a new emphasis placed on work contents and also on skills, levels of competence, and know-how. There are some 480 definitions of occupations, deliberately described in rather broad terms, to facilitate opportunities for mobility between more specific jobs. To identify more precisely a job vacancy and to facilitate the matching with workers' characteristics, each occupational description is completed with a set of additional codes. These may refer to the type of equipment used, the product, the firm, the individual status (independent or wage earner), working conditions, and so on. Each code is specific to a particular occupation. By combining the different codes, thousands of combinations are possible, which should allow for precise identification.

When the system was initially conceived, it was anticipated that it should be possible to translate data between this new ROME and the statistical classification. It now seems to be difficult, in view of the basically different concepts. For instance, clerical personnel employed by government and by private firms belong to different major groups in the statistical classification, while they are distinct only with a specific code in the ROME system. So are masons or electricians, for instance, whether they are independent workers or wage-earners.

The same difficulties arise with regard to the relationship with ISCO and with the European system which is being developed on the basis of ISCO. In addition, problems are now arising with regard to the connection between ROME and the future European system to be used for international placement. These are discussed in another paper.

Issues of occupational classification in Algeria and Morocco

A few additional comments may be made with reference to the experience of the present situation in Algeria and Morocco. Both countries are initiating a process of review of their occupational classifications. Both have been using an aggregated version of ISCO for statistical purposes after having developed more specific classifications. In Morocco, the effort was aimed more specifically at educational purposes (analysis of skills and training requirements). In Algeria, a very detailed classification had been developed for the determination of wages in the dominant public sector.

Both countries are faced today with the same type of issues: Do they use a single system, or different independent systems, or inter-related classifications? Will they simply adopt ISCO, or adapt it to their own context, or use a new Arab classification, which is itself related to ISCO? Will it be the core of the system? To what extent can they use the different classifications developed in a different context (shift from a system conceived for public enterprises to a more diversified private system)?

Answering these questions requires, of course, a clear understanding of their methodological aspects. There may be some expectations that a single and uniform classification would provide a common language, or even more, a tool to solve the planning issues. As suggested above, such expectations might be disappointed. There are also fundamental issues which are of a more political nature: choice of the planning or management approach of the economy and the society and the relationship between the institutions concerned. In most countries, statistical offices have a dominant role and they would prefer to use the ISCO classification, possibly with minor adjustments. From the technical point of view, it is also clear that building an occcupational classification system is a time-consuming and costly effort which requires specific and scarce skills. Most countries cannot afford it and the question should always arise whether it is worth the effort.

Table 1. Skill level

Skill level	Level of most adequate training	Usual duration of practice to do the job adequately	At least additional specialist experience	At least total specialist experience
Elementary	primary education	<1 month		
Low	primary education	<1 month	5 months	6 months
Low	secondary education, first stage	1–6 months		
Middle	secondary education, first stage	1–6 months	6 months	12 months
Middle	secondary education, second stage	6–12 months		
High	secondary education, second stage	6–12 months	12 months	24 months
High	higher education, first stage	12–24 months		
Academic	higher education, first stage	12–24 months	24 months	48 months
Academic	higher education, second stage	12–24 months		

is put by definition one level lower than the level of this training program.

The specialist job experience is in table 1 divided into the usual duration to get thoroughly acquainted with the job (duration of practice to do the job adequately) and the duration in which new skills are learned on the job. The usual duration to get thoroughly acquainted with the job varies with skill level. For jobs for which "primary education" is the most adequate training program, this is less than 1 month. Jobs for which the first stage of secondary education is the most adequate, this is 1–6 months. For jobs for which the second stage of secondary education is the most adequate, this is 6–12 months. For jobs for which higher education is the most adequate, usually 12–24 months of experience is necessary to get thoroughly acquainted with the job.

The additional specialist job experience is that experience that is needed above the usual duration to get thoroughly acqainted with the job. In this column, the minimum additional experience is given to obtain a higher occupational level. The duration of the additional specialist job experience is mostly shorter than the duration of the formal training program, as the curriculum of the training programs contains other subjects than specialist vocational training. The only exception is the second stage of higher education, which contains mainly vocational training.

In the last column, the total specialist job experience is shown (maximum of the duration to get thoroughly acquainted with the job plus the minimum of the additional specialist job experience) that is necessary to obtain a higher occupational level for the given level of the most adequate training.

Skill specialisation. The major and minor specialisations are operationalised according to the educational sectors in the Netherlands. We have made use of the sectors employed in the NSCE. As the NSCE was not developed for labour market research, it was necessary to aggregate the categories of the NSCE in a different way. The results are shown in table 2. For this new aggregation, we adopted the following criteria:

- The substitutability or transferability of labour. To avoid the problem of jobs that are not substitutable within the same occupation, it was decided to form specialisation categories that would reflect labour market substitutability. This does not mean that we accepted actual mobility of labour as a criterium for the classification. Because other characteristics of the labour force determines the actual mobility of labour (such as gender, age, and health), actual mobility patterns do not reflect the substitutability as a consequence of similar required skills. In principle, it is possible that between two occupations which required skills are almost the same, no actual mobility exists as gender, age or health barriers prevent that.
- In order to avoid a result in which some occupational fields are very large and some others are very small, we strived for balanced cell frequencies. To accomplish this, we detailed the larger occupational fields (such as the technical and clerical occupational field) to a greater extent than the smaller occupational fields.

For some occupations, the most adequate training program does not indicate the required skills very well. For these occupations, we used the character of the job experience to classify them in one of the major and minor specialisation categories. This is the case for e.g. managers and public administration employees. Besides the field of knowledge they have to cover, managers need skills to manage their firm or department. Public administration employees need administrative skills and knowledge of the field in which they work to do the job properly. We created separate categories for these occupations, which reflect the real required skills. The managers and the public administration employees are divided according to the field of knowledge they cover.

Another example of an occupational field in which the most adequate training program does not reflect the differences in required skills, are the occupations for which primary education and more than 6 months on-the-job training is the most adequate. If we would accept that these occupations are not divided according to their specialisation, this would suppose that a labour market segment at this level occurs in which labour is substitut-

able. This seems not the case. Therefore, at first, we divided the general specialisation into several categories according to the field of experience that is needed to do the job properly. Because only one category in the general specialisation was needed to characterise the required skills of jobs that actually occur, we decided to reduce the amount of categories to two: general education with and without additional job experience.

Table 2. The major and minor skill specialisations

01	**General**
011	only general education required
012	general education with some job experience
02	**Teachers and staff in education, educational sciences**
021	teacher's training programmes regardless specialisation
022	programmes for educational sciences, pedagogy
023	general teacher's training programmes
024	teacher's training programmes with agricultural specialisation
025	teacher's training programmes with specialisation in mathematics and natural sciences
026	teacher's training programmes with technical specialisation
027	teacher's training programmes with specialisation in transport, communications and traffic
028	teacher's training programmes with (para)medical specialisation
031	teacher's training programmes with specialisation in economics, business administration, business correspondence
032	teacher's training programmes with specialisation in law, law enforcement, security
033	teacher's training programmes with specialisation in language and culture
034	teacher's training programmes with specialisation in social behaviour and society
035	teacher's training programmes with specialisation in home economics and service trades
04	**Agriculture**
041	agricultural programmes regardless specialisation
042	agricultural programmes with agricultural specialisation
043	agricultural programmes with technical specialisation
044	agricultural programmes with economic, clerical, commercial specialisation
05	**Mathematics and natural sciences**
051	programmes in mathematics, natural sciences
06	**Technical**
061	technical programmes regardless specialisation
062	programmes in architecture and for the building trades
063	programmes in civil engineering and geodesy
064	programmes in metal-working
065	programmes in mechanical engineering
066	electrotechnical programmes: computer science, industrial automation
067	electrotechnical programmes not elsewhere classified
068	programmes for the printing trade
071	programmes in chemical engineering
072	technical programmes not elsewhere classified (physical engineering, applied mathematics, textile and leather trades)
073	programmes in law enforcement and security with technical specialisation
08	**Programmes in transport, communications**
081	transport, communications, programmes regardless specialisation
082	programmes in transport, communications, with transport, communications specialisation
083	programmes in transport, communications, with technical specialisation
084	programmes in transport, communications, with economic, clerical, commercial specialisation
085	programmes in transport, communications, with specialisation in home economics and service trades
09	**Medical and paramedical**
091	medical, paramedical programmes regardless specialisation
092	medical, paramedical programmes with medical, paramedical specialisation
093	medical, paramedical programmes with exact, technical specialisation
094	medical, paramedical programmes with economic, clerical, commercial specialisation
095	medical, paramedical programmes with specialisation in home economics and service trades
096	programmes in law enforcement and security with medical, paramedical specialisation
11	**Economics, clerical and commercial**
111	economic, clerical, commercial programmes regardless specialisation
112	programmes in general economics, business economics
113	programmes in management science
114	programmes in electronic dataprocessing and clerical automation
115	clerical programmes not elsewhere classified
116	commercial programmes (including public relations, marketing, banking and insurance business)
117	programmes for the retail trade
118	economic, clerical, commercial programmes nec
121	economic, clerical, commercial programmes with specialisation in mathematics, natural sciences
122	programmes in law enforcement and security with economic, clerical, commercial specialisation
13	**Juridical, public administration, law enforcement, and security**
131	juridical, public administration, law enforcement and security programmes regardless specialisation
132	juridical, public administration programmes
133	public administration with educational specialisation
134	public administration with agricultural specialisation
135	public administration with technical, natural sciences specialisation
136	public administration with medical, paramedical specialisation
137	public administration with economic, clerical, commercial specialisation
138	public administration with specialisation in socio-cultural fields, humanities, theology, fine arts
141	public administration with specialisation in home economics and service trades
142	programmes in law enforcement and security with specialisation in law enforcement and security
15	**Language and culture**
151	programmes in humanities
152	library and documentation programmes
153	fine arts programmes
154	language and culture programmes regardless specialisation
16	**Social behaviour and society**
161	programmes in social behaviour and society regardless specialisation
162	programmes in theology
163	programmes in social work, socialization, school and vocational guidance
164	programmes in journalism
165	sociology and behavioral science programmes

Table 2. The major and minor skill specialisations—Continued

17	**Home-economics and service trades**
171	programmes in home economics and service trades, regardless specialisation
172	programmes in home economics and service trades, with specialisation in home economics and service trades
173	programmes in home economics and service trades, with economic, clerical, commercial specialisation
174	programmes in law enforcement and security with specialisation in home economics and service trades
18	**Management**
181	management regardless specialisation
182	management with educational specialisation
183	management with agricultural specialisation
184	management with specialisation in mathematics, natural sciences
185	management with technical specialisation
186	management with transport, communications specialisation
187	management with medical, paramedical specialisation
188	management with economic, clerical, commercial specialisation
191	management with juridical, public administration, law enforcement and security specialisation
192	management with specialisation in language and culture
193	management with specialisation in social behaviour and society
194	management with specialisation in home economics and service trades

In some occupational fields we are confronted with labour market segments for which broad skills are required. For these occupational fields more than one training program gives entrance into the jobs and none of these training programmes can be described as the most adequate. Therefore, we added a minor specialisation category "regardless specialisation" for all major specialisations. Exceptions to this rule are the major specialisations "general" and "mathemetics and natural sciences." Within the major specialisation "general" the category "only general education required" fulfills the same function. As the major specialisation "mathemetics and natural sciences" is not subdivided up into minor specialisations, a separate category "regardless specialisation" is not necessary.

Main tasks. For some users, the classification according to level, major, and minor specialisation is not detailed enough. Therefore, these categories are subdivided according to the main tasks. The main tasks are associated with specific skills, which are suitable for describing different visible labour market segments. Specific skills are skills that usually are not learned at school but are more or less personal characteristics. The list of 128 task clusters is shown in table 3. Our point of departure was a list of 114 task clusters of the Netherlands Central Employment Board, which is used to match the characteristics of vacancies and the work performed in the latest jobs of the unemployed. This list was adjusted in order to make it suitable to apply to the classification.

Table 3. The 128 task clusters

Code	task cluster
001	managing supervisors and decision-making general policy
002	supervising workers and decision-making general policy
003	supervising workers without decision-making general policy
004	decision-making general policy without supervising
005	preparing concepts for general policy
006	planning/coordinating work
007	preparing estimates of costs
008	overseeing implementation of legislation
009	advising on legal, taxation subjects
010	advising on organisational subjects
011	advising on marketing, economic subjects
012	advising on technical, technological subjects
013	advising on social, societal subjects
014	informing
015	conduct research without strong numerical aspects
016	conduct research with strong numerical aspects (technician work excluded)
017	conduct chemical and physical tests and analyses (technician work)
018	check, inspect, examine, verify, test, sort
019	write, edit, translate
020	design, advising on information technology
021	maintain, process computer software and operating systems
022	design
023	prepare technical drawings, calculate, take measurements
024	personnel work
025	secretarial work
026	clerical work with numerical aspects
027	clerical work: overseeing rules, regulations
028	clerical work with linguistic aspects
029	typing/word processing
030	archive, library work
031	auxiliary clerical duties
032	recieve clients (reception work)
033	trade (retail excluded)
034	buy
035	sell: agent work
036	sell: shop work
037	receive payments in shops and similar establishments
038	store, issue
039	load, unload goods
040	deliver
041	transport, carry
042	operate mobile machinery, cranes
043	fly an aeroplane
044	navigate a ship
045	drive a train, tramcar, subwaycar
046	drive a heavy-truck, lorry
047	drive a bus, coach
048	drive a passenger car, delivery van
049	guard, safeguard, patrol
050	domestic cleaning (office cleaning included)
051	industrial cleaning
052	melt, mould, cast
053	metal-fitting (one specific tool)
054	metal-fitting (more than one specific tool)
055	making (machine) tools, precision metal-fitting
056	plastic modelling

Table 3. The 128 task clusters—Continued

057	sheet metal work	094	assemble
058	welding, flame cutting, soldering	095	pack by hand
059	insulate	096	demolish
060	install pipes (installation technique)	097	disassemble
061	erect constructions	098	manufacture, repair (craft)
062	fit, erect, install machinery	099	teach
063	fit, erect, install, repair mechanical equipment	100	instruct (physical)
064	maintain, repair (motor-)vehicles	101	heal humans
065	fit, maintain strong current	102	give technical medical assistance
066	fit, maintain weak current	103	give medical assistance (technical excluded)
067	fit, maintain elektronics	104	sterilize
068	lay bricks, pointing walls, set tiles	105	physiotherapy
069	plaster	106	guide humans with personal and social problems
070	concrete, reinforce concrete work	107	providing nursing care
071	carpentry	108	provide personal and housekeeping services
072	operate woodworking machine	109	take care of personal appearance
073	cover floors, upholster	110	heal animals
074	paint, spray paint	111	give veterinary assistance
075	fix glass, cut glass	112	care of, train animals
076	roofing	113	hunt, fight against vermin
077	maintain work: carpentry, lay bricks, fix glass	114	horticultural work
078	maintain work: elektric installations	115	gardening work
079	maintain work: gas, water, heating installations	116	arable farming work
080	make roads, digging work	117	cattle-breeding work
081	preparation of printing material: text	118	forestry work
082	preparation of printing material: images	119	fishery work
083	print	120	operate equipment for images and sound, transmitting broadcasts, lighting
084	binding books	121	act, direct
085	manufacturing of ready-to-wear clothing, tailoring	122	announce, present (broadcasting) programmes
086	preparing fur, manufacturing leather products	123	present personal appearance
087	clean, cut, dress, slaughter meat and fish	124	dance
088	prepare food (no fast food)	125	sing
089	prepare food (fast food)	126	play musical instrument, conduct, compose
090	serve food and beverage	127	make visual arts
091	operate production machines	128	do competitive sport
092	setting up production machines		
093	monitor production processes		

Table 4. The eleven specific skills

1. Quantitative skills	Activities in which it is important to perform calculations.
2. Technical skills	Activities involving the operation of machines and tools.
3. Supervisory skills	Activities consisting of directing and controlling other workers.
4. Organizational skills	Activities in which it is important to plan and organize one's work, including arranging and filing documents, tools, goods and materials.
5. Verbal skills	Activities in which it is important to express thoughts and feelings in written or spoken words.
6. Artistic skills	Activities in which it is important to be artistically talented and to pay attention to aesthetics.
7. Serviceability	Activities in which it is important to render service to other people.
8. Persuasiveness	Activities in which it is important to influence other people.
9. Craftsmanship	Activities in which products or parts of products are manufactured by hand or with simple tools.
10. Spatial discernment	Activities in which it is important to visualize spatial relations, to judge distances and cubic measures.
11. Attentiveness	Activities in which it is important to pay attention to relevant details of the work.

First, we distinguished 11 specific skills (table 4). If one of the 114 original task clusters was heterogeneous according to 1 of the 11 specific skills, this task cluster was divided into 2 or more task clusters. These specific skills are not used for classification purposes, but are given as descriptive information. We did not score these skills directly for each occupation. We decided for each main task if one or more of the specific skills are required to do that task sufficiently. Because each occupation is characterized by these tasks, it is possible to derive the specific skills from the main tasks. This opens up some more avenues for other descriptive information such as health risk factors.

Second, we checked whether the task clusters would lead to balanced cell frequencies. If a task cluster described the tasks of a very large occupational field, we divided the task cluster into two or more new ones.

The Analyses of Job Descriptions

With the formulation and operationalisation of the criteria, we have described the potential categories of the new classification. But we do not know whether all of the categories are filled with occupations that actually occur and which occupations are in these potential categories. In order to answer these questions, job descrip-

tions were collected and analyzed. This information was not collected on the CBS itself. Instead, we carried out secondary analyses on existing sources of occupational information. In the Netherlands, there is no system of job descriptions which covers information on all jobs in society. In order to cover as much information on occupations as possible, information was collected from several occupational data systems, describing parts of the occupational field. For instance, we used data from the Netherlands' Central Employment Board, job descriptions drawn up for the evaluation of government jobs, a number of sector oriented publications (for instance on automation jobs, jobs in education, jobs in public health), and job descriptions from various collective labour agreements. All of these job descriptions contain information on the criteria of the classification.

On the one hand, these job descriptions were classified according to the criteria of the classification (level, major and minor specialisation, and main tasks), and on the other hand, they were classified according to the usual titles and descriptions of job activities. The criteria were coded for all of the job descriptions. When we started this work, it became clear that it was not an easy task. To guarantee the coding quality, we decided to code the criteria of a job by two persons independently, and confront the values of the two coders. In the case of dissenting opinions between the coders, a decision was taken jointly.

In all, approximately 3,400 job descriptions were analyzed. Using our old 1984 occupational classification (CBS, 1984), the field of occupations examined which areas had not yet been covered. We verified that approximately 60 percent of all different jobs in the Netherlands were covered. For the rest of the 40 percent of jobs, we added job descriptions of our own. Of course, in the determination of the criteria values, we made use of the job descriptions we already analyzed, by seeking equivalent jobs. Therefore, we added almost 2,200 job descriptions, which were not in one of the analyzed job descriptions from existing sources.

The coded job descriptions were then sorted on level, major and minor specialisation, and main tasks. This means that the classification is structured according to the criteria in which level has the first, major specialisation the second, minor specialisation the third, and main tasks the fourth priority. It is therefore assumed that the main tasks and the associated specific skills are less important for the substitutability of labour than level or specialisation. This results in 1,211 occupations.

The occupational code contains five digits. The first one for the occupational levels; the first two for the combinations of skill level and major skill specialisation; the first three for the combinations of skill level, and major and minor skill specialisation; and the complete code for the occupations (combinations of skill level, major and minor skill specialisation, and main tasks). The occupational code is designed to show the criteria values for the occupations. This makes the classification easy-to-use. The occupational levels are coded into five categories:

100 elementary occupations;
200 low level occupations;
400 middle level occupations;
600 high level occupations;
800 academic occupations.

The first three digits of the occupational codes are formed by adding the code for minor specialisations to the code for the level. The last two digits are a sequence number for the differentiation according to the main tasks.

The Formation of Occupational Groups, Classes, and Levels

As the NSCO'92 was developed for statistical purposes, it was necessary to formulate some statistical limiting conditions. On the one hand, the NSCO'92 should not contain very small categories, because it would not be possible to publish reliable results. One of the problems of the old occupational classification was that many cell numbers were insufficient to give reliable results in the Netherlands' Labour Force Surveys. On the other hand, the NSCO'92 should not contain very large categories, because the results would not be well-balanced. Therefore, in the operationalisation of the criteria large occupational fields were differentiated more than smaller occupational fields. Moreover, in the formation of occupational groups, classes, and levels, small categories are grouped together with other categories with almost similar criteria-values.

Table 5. The occupational levels, classes and groups in the NSCO'92

Criteria	Classification
1. 5 skill levels (table 1)	5 occupational levels.
2. 13 major skill specialisations (table 2)	43 occupational classes.
3. 87 minor skill specialisations (table 2)	121 occupational groups.
4. 128 main tasks (with a maximum of three tasks for each occupation) (table 3)	1211 occupations.

Initially, occupational groups are formed by occupations who are similar according to skill level and specialisation. To solve the problems of reliability for the new classification, we required a lower bound for the occupational groups of 5,000 job incumbants in the population. When occupational groups had less than 5,000 job incumbants, they were taken together with other occupational groups, that had comparable criteria values. The criterium for joining occupational groups was the substitutability of labour. If labour in two occupational groups

Table 6. The occupational classes in the NSCO'92: skill level and major skill specialisation

Major skill specialisation	Skill level				
	Elementary	Low	Middle	High	Academic
01. General	11	21	•		
02. Teachers and staff in education		22	42	62	82
04. Agricultural		24	44	64	84
05. Mathematics and natural sciences		25	45	65	85
06. Technical		26	46	66	86
08. Transport, traffic and communications		28	48	68	•
09. Medical and paramedical		29	49	69	89
11. Economics, clerical and commercial		31	51	71	91
13. Juridical, public administration, law enforcement and security		33	53	73	93
15. Language and culture			55	75	•
16. Social behaviour and society			56	76	96
17. Home economics and service trades		37	57	77	•
18. Management			•	78	98

"•" combinations of skill level and major skill specialisation taken together with others, as a consequence of insufficient cell numbers

that were taken together was well substitutable, the resulting classification would be a good instrument for describing supply, demand and substitutability on the labour market. In practice, we take occupations into occupational groups together with equal levels unless the substitutability of labour between levels is evidently larger than between specialisations. Of course, only those specialisations were taken together, which can be assumed to be well substitutable.

The occupational levels, classes, and groups are given in table 5. We start with five occupational levels. The occupational levels are differentiated into 43 occupational classes with the use of the 13 major specialisations. The 43 occupational classes are again detailed with the use of the minor specialisations into 121 occupational groups. The occupational groups are successively differentiated according to differences in tasks into 1,211 occupations.

In table 6, the resulting occupational classes are shown. In the first column, the major specialisations are given. The occupational classes are formed by combination of the major specialisation and the level of the required skills. Not all of the categories are used in our classification: some combinations of level and major specialisation do not contain any occupations.

The resulting occupational classes, occupational groups and occupations are denoted by a title. The titles of the occupational classes and groups are based on the criteria used to construct the classification. So, the title of occupational class "57" is "middle level occupations in home economics and service trades." The titles of the occupations are a summary of frequently used titles of jobs in that occupation.

Differences with the ISCO'88

We choose skill level and skill specialisation as the main criteria for our new classification. Because these criteria are the same as the criteria used in ISCO'88, it would have made sense to translate ISCO'88 into Dutch. In this section, we will give the arguments why we decided to develop a national classification instead of a translation of ISCO'88.

ISCO'88 classifies jobs according to the required skills. These are divided into two dimensions: skill level and skill specialisation. Skill level was defined as "a function of the complexity of the range of the tasks and duties involved." The first difference in the operationalisation in skill level is that ISCO'88 contains four skill levels, while the Netherlands' Standard Classification of Occupations contains five skill levels. In table 7 this difference is shown. In our classification the second skill level of ISCO'88 has been divided in the first and second stage of secondary education. In the Netherlands this difference is extremely important. It is the difference between skilled workers and almost unskilled workers. Furthermore, more than half of the labour population has an occupation in these levels, so we need criteria to diversify them into more detailed categories. Therefore, for the Netherlands, it is important to distinguish at least five skill levels to make a valid description of supply, demand, and substitutability on the labour market. Moreover, the difference between the second and third skill level in NSCO'92 is important for research on social stratification, as this diffence is important for social status.

Table 7. The skill levels of ISCO'88 and NSCO'92

ISCO'88	NSCO'92
1. primary education	1. primary education
2. first and second stage of secondary education	2. first stage of secondary education
3. first stage of higher education	3. second stage of secondary education
4. second stage of higher education	4. first stage of higher education
	5. second stage of higher education

The second difference is, that in ISCO'88 the concept of skill level was not applied in the case of major groups "Legislators, senior officials, and managers" and the "Armed forces." The reason for this was that the skills for executing tasks and duties of occupations belonging

to each of these major groups vary across countries. In the case of the Netherlands, it was possible to link skill levels to the jobs in these major groups.

The third difference is that skill level two in ISCO contains four major groups. This means that the first digit of the occupational code does not immediately make clear what the skill level of the major groups is. In fact, the skill level and skill specialisation are mixed to come to the major groups. In the NSCO'92, we do not mix any of the criteria, but reserve one digit for the skill level, one for the major skill specialisation, one for the minor skill specialisation, and two for the main tasks.

The second dimension of skills in ISCO'88 is skill specialisation, defined as "the field of knowledge required, the tools and machinery used, the materials worked on or with, as well as the kind of goods and services produced." This has not been operationalised explicitly, but it points to a mix of skill specialisation and the main tasks as we used these terms. Because skill specialisation had not been operationalised explicitly, it is difficult to control the classification on the application of the criteria. For instance, the teachers in secondary education are not divided according to their field of knowledge in ISCO'88, while differences in the field of knowledge are considerable (unless the practice of teaching as such is considered to be a field of knowledge, and not the specialisation of the knowledge required).

These considerations led to the conclusion that translating the ISCO'88 into Dutch would not result in an adequate description of supply, demand, and substitutability of the labour market in the Netherlands. Therefore, we decided to make a classification of our own, which differs substantially from ISCO'88, but which fully reflects the structure of the labour market in the Netherlands.

Coding Survey Information on Occupations

After the completion of the classification, it is necessary to apply it to survey material. As the NSCO'92 differs substantially from our old national classification and ISCO'88, it can not be converted directly into classifications. As we want to make time-series on the old national classification, and give results on ISCO'88, it is necessary to code three classifications. Because double or triple coding is inefficient, we designed a computer-assisted coding system of occupations which makes it possible to code NSCO'92, the old national classification and ISCO'88 at the same time. How do we manage to do this?

In household surveys, respondents are asked the following six questions with respect to their occupation:

- The title of their job;
- A description of the main tasks within the job;
- Whether their position is an executive one, how many subordinates they have and a description of the executive tasks; and
- A description of the economic activity of the company or firm for which they work.

Almost all surveys of the Netherlands' Central Bureau of Statistics use laptop computers. The interviewers send the outcomes to the Bureau, and this information is brought into our computer system.

The computer-assisted coding system is designed to function almost independently of the actual occupational classification. We have separate operations for coding occupational information from surveys and classifying jobs in one of the classification categories. In practice, we use so-called provisional occupational codes. These provisional codes are not the same as the classification codes: we have more provisional codes than categories in the classification (approximately 2,100 provisional codes and 1,211 and 390 codes in NSCO'92 and ISCO'88, respectively). These provisional codes are used to reduce the information on occupations into categories which contain linguistically similar information. Therefore, the coders do not need to have expert knowledge on the classifications. At a later stage these provisional codes are converted into definite occupational codes on the basis of the occupational classification. Because the provisional codes are made to reduce the survey material on occupations only linguistically, it is possible to convert these provisional codes into several different occupational classifications, for example, the NSCO'92, the ISCO'88, or any other occupational classification. The only thing we need to do is to create a decision table for those occupational classifications.

Conclusions

The method to develop an occupational classification presented in this paper can be applied to all western economies. As the most adequate training program for a job is used to indicate the required job skills, the only condition is that there exists an elaborated educational and vocational training system. It is especially useful if there is a national curriculum, because then it is known what people actually learn in these training programmes. If such a system exists, it is relatively easy to classify jobs according to that system. In the Netherlands, only for a small minority of jobs additional information is needed to classify jobs properly. Because most jobs are classified according to the most adequate training program, we describe supply and demand on the labour market with similar instruments: the required job skills indicated by the most adequate training program (demand) and the acquired skills indicated by the acquired training of the labour supply. Substitutability of labour

indicated by the required skills can be applied to explain actual labour mobility patterns. Moreover, classifying jobs according to skill level and specialisation is also useful for research in the field of social stratification.

Notes

* Bart F.M. Bakker is working at the Netherlands' Central Bureau of Statistics, at the Department for Social Accounts. The 1992 Netherlands Standard Classification of Occupations was developed in collaboration with P.A.H. Andela, J.K. Jonker, J.A. Oud and L.G. Zwarenstein. Address all correspondence to CBS, Department of Social Accounts, B.F.M. Bakker, P.O. Box 959, 2270 AZ Voorburg, The Netherlands.

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Polish Experience in the Application of Occupational Classifications

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The importance of occupational classification

The type of occupation performed is one of the major attributes indicating the position of people, both in the labour process and in the social structure. Whereas the role of occupation in the social distribution of labour has never been doubted in any social-economic system, its importance in the formation of a social structure and influence on inequality and social barriers have not always received proper focus. There is no doubt, however, that since the 1940's, when the United States had begun systematic studies on social structure, occupational differentation has formed the basic aspect of such analysis.[1]

This analytical approach to social structure research in Poland received acknowledgement as late as in the 1970's, because until then the majority of Polish sociologists believed in the leading role of class-stratification formula for explaining the substance of social divisions. However, irrespective of the theoretical concept governing the social structure research, the changes occurring in reality, like the growing division of labour, development of specialization and complexity of labour, expanding variety of activities (jobs) and professional functions, and improvement in organizational methods, this increased professional mobility forced us to follow and study the changes in the occupational structure of Polish population. The more so that occupational position started to implicate basic differences in income, social status, style, and quality of life, that is, in placing concrete occupational groups in the social hierarchy.

Thus, the occupational structure of the population is important for at least two reasons:

- Mechanisms ruling the labour market, the major factors here being demand and supply of professions, changes in occupational structure in the context of occurring economic and technological transformations, and developments in the educational system and professional training,
- Identification of basic social divisions in an industrial society, which exert a strong influence on the rate of and trends in economic development (mutual preconditioning of economic processes and occupational differentiation).[2]

The importance of occupational divisions in Poland, under conditions of a centralized economy, that is, one that applied totally different management tools than is the case in a market economy, was approached in a relatively one-sided way. First and foremost, from the point of view of meeting labour demand is the necessity to implement specific concepts of socio-economic development. Perhaps this is why the occupational aspect of social structure received greater attention in research and surveys only recently. In reality, occupational divisions have always had considerable importance for the formation of social structure of the Polish population. Most often, however, they were the effect of a specific economic policy rather than of an instrument stimulating socio-economic transformations.

One can conclude from the above thoughts that informational needs concerning occupational structure can be and usually are different depending on the economic system, economic management mechanisms, or recognition of occupational roles in the development process. These give rise to concrete expectations with regard to statistical studies on occupational structure, and thus, with regard to occupational classification. It should be emphasised that occupational classification is the necessary tool that preconditions the execution of such statistical studies and analyses. The quality of such classification defines the scope and precision of social and occupational diagnosis and in effect, the possibility of choosing appropriate actions within labour market and social policies.

Within the short time that lapsed it is hard to prepare such a classification of occupations which would meet all the current and prospective needs of research and practice. The changes occurring in the reality surrounding us press on the need of constant modification and improvement in statistical instruments, including classification as well. It is particularly important in conditions of transformation of the system, as now experienced by the Polish economy and population. This is the time when two, often quite different worlds, function in parallel: the previous socio-political system, still significant in Polish reality, and this newly created one linked with the construction of foundations for market economy. Thus, it is all the more difficult a task to elaborate

an occupational classification which would enable proper diagnosis of such a complex system and stimulate desired changes.

In seeking the best possible solutions one should also take advantage of earlier experiences in improving occupational classification, irrespective of conditions under which they were made and used. There are two elements, essential in our view, for correct evaluation of work done so far on Polish occupational classification, namely: classification accuracy and scope of its application. It is from that angle that we shall try to describe the Polish experience in this area.

A bit of history

Poland's experience in gathering information on occupations has a long historical record. The first such attempts in statistical practice date back to early 19th century. They accompanied the population censuses carried out in 1808 and 1810. The population classification applied then used, as one of the major criteria, the ownership relations existing in the then Warsaw Duchy. This method helped to differentiate land owners, landholders, and manufacturers (owners and craft workers). But to classify the population in a more detailed way, some elements of professional characteristics were used as well. In effect, such groups as administrators (governors, stewards, foresters) and house servants (cooks, lackeys, coach drivers, guards) were recognized. Health-care occupations (pharmacists, obstetricians, surgeons, physicians, dentists) were noted as well.

Having regained independence in 1918, the first occupational classification was prepared for the purpose of the Population Census of 1921. That classification at its highest level of differentiation numbered 20 groups. The occupations were linked both according to technological division of labour and social criteria. From many angles this was an innovative approach, well suited to the then available research and the informative needs of Poland. The next population census of 1931 used the same classification, but the information gathered on occupations was not processed. It was only used to determine a few basic groups among the working population: blue- and white-collar workers in the public sector, owners and hired labour in the private sector.

After World War II, the concept of occupational classification suffered from the approach which concentrated itself on the category of an objective occupation, that is, ascribing it to a specific branch of the national economy. That approach prevailed in Polish statistics for quite a long time, a fact that considerably restricted analytical possibilities. Relying on such a classification only simplified the division. Data on blue- and white-collar workers could be obtained, as well as data on the size of human resources in individual branches of the national economy. It is no wonder that the statistical practice soon revealed all the deficiencies of such an approach towards occupational classification.

Major lines of classification improvement

The exceptionally hard demographical situation of Poland after the end of World War II and the adopted strategy of the country's industrialization forced the political leadership to take a more thorough study of qualification and occupational needs of the economy, to estimate the use of professional potentials of the population, and to work out desired policies in professional education.

The existing data on objective occupations became insufficient when confronted with growing demands for information on the scope of qualifications of the population. The lack of a single standard occupational classification was also a disadvantage. Thus, it became necessary to prepare such a classification, but with regard to subjective occupations, reflecting individually performed activities (jobs) irrespective of the type of work (economic activity) pursued by the establishment.

This task was undertaken by the Committee of Labour and Pay and resulted in a classification called "Nomenclature of Occupations and Specializations." It covered only those occupations and specializations which required at least 3 months of professional training. This approach stemmed from the adopted definition of the occupation, in keeping with which "occupation or specialization is understood as the performance of a number of socially useful actions, based on possessed qualifications (knowledge, skills) and resulting from the division of labour, for the purpose of acquiring means of subsistence."[3] Thus, the main criteria for assigning occupational categories were:

- Division in accordance with qualifications acquired at school or during on-the-job training, and
- Technological division of labour.

Other equally important factors differentiating occupations, such as the level of responsibility and position within the enterprise structure, were not included. Occupations specific to the armed forces, police, public administration, and political and social organizations were also left out. Statistical services in their research practice used to supplement this classification with occupations omitted from the official classification, but it could have had an adverse effect on cohesion of the classification. The practice of ascribing certain occupations to basic branches of the national economy (for example manufacturing, construction, transportation, communication) has not been dropped all together.

The first official classification included 2,424 occupation-specializations (5-digit symbols), which were arranged in 246 unit groups, 69 minor groups, and 9 major groups. "Occupation-specializations are combined into a group according to the rule of their highest proximity understood as those assigned to one group are linked

more tightly with each other than with any other occupation-specialization from the outside of the group."[4]

In spite of certain methodological shortcomings in concept itself, this first classification of occupations, implemented in 1966, meant considerable advance and saw fairly wide uses. Among others, it was used in:

- Statistical research on employment according to occupation,
- Preparation of balances of human resources and outlining the distribution of qualified labour,
- Adoption of professional education policies, and
- Coordination of schedules' preparation.

As a result of changes occurring in the economy, technological development as well as experience in conducting statistical surveys, the nomenclature of occupations and specializations were constantly supplemented. This situation had to lead to preparation of a new version of the classification of occupations and specializations. This new Modified Classification of Occupations and Specializations (that was its official name) was officially adopted in 1982. It was "a systemized set of occupations and specializations occurring in the national economy and obligatory for educational system." It included both the professions learned at school and acquired outside the educational system as well as occupations performed.[5]

Major changes made in that classification boiled down to the introduction of new occupations and specializations which combined some of the occupations and specializations that disappeared as a result of a new educational policy, in particular, those striving to prepare specialists with a wider profile. New principles of grouping occupations and specializations as well as of classifying educated and performed professions were introduced. This time the classification used a 3-level division of occupations and specializations (instead of a 4-stage one as in the previous system), which differentiated 56 major groups, 404 unit groups, and 2,610 occupations and specializations (6-digit code).

It should be stressed, however, that this modified classification system failed to introduce any significant changes in the methods and concept of occupational division. No major changes were made in the definition of occupations, apart from differentiation between educated and performed occupations. In effect, this modification of classification had a strictly formal character, that in no essential way did alter its accuracy or its scope of application.

The classification of occupations and specializations of 1982 is still in force as the sole official one, although research practice made it necessary to introduce further modifications and adjustments to meet specific statistical needs.

One might think that it is fairly easy to adjust the basic classification of occupations and specializations to the needs of the educational system (school nomenclature). The idea was to find a common name for the identical set of practical and theoretical skills acquired in different schools. In practice it was not that easy. Vocational education prepared the labour force to meet the needs of the individual region, or even an individual concrete establishment. As a result, curriculums preparing for the same profession often differed considerably from school to school, a fact impossible to grasp in a universal classification of occupations. Thus, it was impossible to stick only to the Classification of Occupations and Specializations. The pressing necessity was to elaborate a school nomenclature of occupations, which, in fact, had to undergo constant updating as well.

Even greater practical problems were encountered while using the occupational classification in studying employment within the frames of specialized employment (staff) and population censuses. Each specific survey required the application of a different version of the occupational classification, varying, above all, in its amount of detail. This is quite understandable, because the goals behind each census are substantially different. Hence, there is a double-track effort on adjustment and improvement of the occupational classification for statistical purposes.

Occupational classification in employment censuses

The demand for a detailed study of a population's level of qualification and degree of its use in the process of work, as well as the need to determine the demand for qualified personnel on the part of the economy so as to specify required areas of vocational education, resulted in the development of specialized research on the occupational structure and qualifications of the working population.

As of 1958, periodic surveys of qualified personnel employed in the public sector had been started. Initially these surveys covered people with higher and secondary (intermediate) education, but were expanded in 1973 to cover the rest of the employed. In effect, 97 percent of the employed in this sector were researched (only the military, police, and penitentiary services were left aside). No research was made on the employed in individual farming and non-agricultural private sector. One of the major objectives was to learn about the vocational and qualificational structure of the employed, which gave rise to the question of having an appropriate occupational classification at hand.

The first employment census of 1958 surveyed educated occupations only—the especially prepared classification for this purpose limited itself just to major occupational groups—taking account of the curricula provided in higher schools and secondary vocational schools. In addition, information was gathered on the type of activity of the establishment, that together with educated occupation enabled to assess the percentage of vocationally pre-

pared labour in individual branches of the national economy. At that time this was information of major importance for diagnosing purposes, but still insufficient to meet all the outstanding demands from the point of view of appreciating the degree to which qualified labour was used, as well as from the point of view of the needs in specialists in specific areas voiced by the national economy.

The next census of 1964 expanded its surveys to include occupation performed, however, the classification of educated occupations was still applied (as in the previous census), the only difference being its increased detailing up to individual vocational specializations.

Since 1968, the officially enforced classification of occupations and specializations (at first the one of 1966 and then the one of 1982) has been applied both to describe the employed in keeping with their educated occupation as well as the actual one performed. At the same time the scope of studies has been increased by taking into account the data on jobs which enabled a more precise location of the employed within the organizational structure of the establishment, and thus better describe individual occupational groups of workers.

At the beginning, jobs were surveyed only in case of managerial staff, assuming that managerial skills are equally important as other professional qualifications. A separate classification of such jobs has been prepared for that purpose. It was to provide additional information on the occupation performed, including the scope of responsibilities, share in the managerial process, and position in the organizational structure of the establishment. This classification saw further expansion to meet the needs of other employment censuses by including further groups of work positions that enabled it to include all the employed on nonworkers' positions.

It should be emphasised that the initiative to introduce surveys on jobs for supplementing occupational characteristics, as well as on the duty to prepare classification of jobs came from statisticians who performed employment surveys. Later it proved to be a very important tool in labour planning and management. Parallel use of occupational classification and classification of jobs considerably boosted the potentials of employment qualification characteristics. It should be noted, however, that the need to use two classifications (occupation-specialization and jobs) vividly pointed to the imperfect nature the official Classification of Occupations and Specializations. Whereas treatment of the two above mentioned classifications as independent ones hampered international comparability of surverys and comparability of different surveys performed in the country. Continuation of this state of affairs in present conditions (construction of totally new economic instruments) is highly unadvisable.

As of 1983, no employment census has been performed in Poland. Reforms launched in the Polish economy and the introduction of market economy instruments gave rise to new expectations and tasks with regard to statistics, including employment statistics. The conditions for performing statistical surveys and the suitability of hitherto data gathering methods have also changed.

In our view, the decision to renounce employment surveys in Poland is final. It is so, because a new source of data on the labour market is now available, namely the labour force survey. It is in the framework of this study that the need for an appropriate occupational classification has been voiced. Initial decision to this end was to use the occupational classification applied in the population census of 1988. However, since May this year, a simplified version of the international classification of occupations—ISCO 88 is used in the labour force survey—adjusted to conditions of the survey and national specifics. This is but a provisional solution and we all are looking forward to seeing a new occupational classification that would meet international standards.

Occupational classifications in population censuses

Information on the occupational structure of population received in effect of employment surveys was extremely useful, but failed to guarantee complete data. This information was limited only to the employed, moreover to the employed in the public sector. Thus, numerous groups of the population remained outside the statistics, in particular those temporarily inactive and those employed in the private sector. Under these circumstances population censuses have played a significant role by supplementing information on the occupational structure of the entire economically active population and with respect to educated occupations.

It is understandable that due to the scope of a population census, its range and organization, an identical methodological approach is not always possible to apply, as is the case with other statistical surveys. A good example here is occupational research. This is why the occupational classification used in censuses differed considerably from the classification used in other surveys, being different also from the officially binding classification of occupations and specializations.

The first two post-war population censuses used an occupational classification which took advantage of the objective occupation concept. It proved unproductive in estimating occupational structure of the population, so it was decided that the results of the 1950 and 1960 censuses, in that respect, would not be processed at all.

Consequently, before the next population census of 1970 there appeared a need to prepare a new occupational classification, which would meet the needs of such a survey. It had to be more synthetic (that is, less detailed) and should combine the characteristics of the employment status, position, and type of activity performed. Conducive to this end were the different efforts carried on in Poland on occupational classification and classification

of jobs as well as the availability of data presenting outlines for the revision of the international classification of occupations—ISCO 59.

This environment encouraged the Central Statistical Office to prepare a census classification of a totally new approach towards occupations performed. For the first time, in the population census of 1970, occupations were treated as a set of activities performed irrespective of the type of activity performed by the establishment. This was the first attempt to combine occupations and jobs into a single (consolidated) classification. Thus, the occupational classification prepared for and used in the census of 1970 to a much greater degree resembled the ISCO 68 classification than the Polish classification of occupations and specializations of 1966.

One should also add that wide-ranging surveys require an appropriate instrument to correctly assign the names of individual occupational actions to proper category within occupational classification. To this end, apart from the basic census classification of occupations terminological glossaries (*Dictionary of Occupational Titles*) were prepared (that is, occupational indexes including some 15,000 individual names in systematic and alphabetical order). It proved extremely useful not only during the census of 1970, but, after some amendments, also in the subsequent censuses of 1978 and 1988. Even 5 years after the last population census these occupational glossaries still remain highly sought after publications of the Central Statistical Office.

Census year	Groups		
	Major	Minor	Unit
1970	9*	165	368
1978	5	94	288
1988	4	97	374

* In 1970, major groups were additionally divided into 47 subgroups.

The occupational classification prepared for the purposes of the census of 1970, because of its innovative and totally different approach (for that time) from what was used so far, was still an imperfect proposal. The difficulties boiled down mainly to ensure proper aggregation of individual occupations. However, the experience gained during that census made it possible to prepare improved occupational classifications for subsequent censuses of 1978 and 1988. In this respect, the cooperation established between the Central Statistical Office and the Institute of Philosophy and Sociology of the Polish Academy of Sciences proved most helpful. The studies conducted by that Institute contributed to preparing an occupational classification which enabled better reflection of genuine occupational divisions in Poland and wider application of the classification in social reseach. Despite considerable complexity of that classification, it was still more synthetic than classifications used in employment surveys, and one finds proof in the number of occupational groups it distinguished.

Occupational classifications in social research

Social research, sociological in particular, forms a separate area where occupational classifications are applied. The difference in requirements set forth before occupational classifications designed to serve social studies consist in the need to provide a synthetic occupational division. It should enable differentiation of uniform occupational groups, internally coherent, which at the same time would reflect major aspects of occupational divisions. Such requirements substantially differ from expectations attached to universal occupational classifications, which are to perform wider tasks in statistical surveys.

There is no doubt that a special classification meeting specific research objectives can be tailored also for the purposes of social research. In fact, sociologists often use such practice. But that approach hardly contributes to integration of research, accumulation of knowledge, and comprehensive analysis of social and occupational changes within population. This is the reason why occupational classifications used in basic social research should be tightly related to a universal classification. Only the specific goal of the research should decide upon the complexity of classification. To a certain extent, this objective has been reached in Poland thanks to the collaboration between the Central Statistical Office and the Institute of Philosophy and Sociology of the Polish Academy of Sciences. This refers, however, only to the compatibility of results of the population census with certain sociological studies. The complete classification of occupations prepared for and used in the censuses of 1978 and 1988 served as basis for the elaboration of socio-occupational classification, which has found application in many sociological studies. For the purpose of preparation of results of the 1978 census, 32 socio-occupational groups have been established; for the same task with results of the 1988 census, 17 socio-occupational groups were established. It should be noted, however, that this compatibility of census classification and the ones used in sociological research was achieved only by the late 1970's.

The following areas of social research have been developed with the application of occupational classification:

• Patterns of social stratification and changes in social structure,
• Social mobility and socio-economic achievement, and
• Occupational structure, status of occupations, occupational prestige, and vertical differentiation among occupations.[6]

The above mentioned topics were the subject of many studies and empirical analyses in Poland. Usually, in researching the social structure and mobility, socio-occupational classification of population was applied. Initially, these were classifications prepared by sociologists for a specific research application, later there were attempts to adopt the socio-occupational classification used in recent census surveys. Such solutions were not always suf-

ficient to correctly relate social and occupational stratification of the population. With a view to preparing a specific occupational classification to be used in sociological research—in particular, on changes in occupational status, on attitudes and behaviour of individuals seen through different elements of occupational roles as well as on other measures of occupational stratification—sociologists in the second half of the 1970's prepared a Social Classification of Occupations.[7] This classification was prepared in three versions taking into account the criteria of complexity of work, occupational prestige, and socio-economic position as the most elaborate factors and because of the multiple uses of the information (educational level, wages, housing standard, possession of durable goods, cultural involvement, scope of prestige). Social classification of occupations proved to be a highly productive instrument in the hands of sociologists, but due to its nature, it could not be applied in employment research and mass statistical surveys. The example of sociological research in Poland shows how big the demand is for a universal classification of occupations, which might serve as a starting point for the creation of synthetic classifications tailored to specific research.

Dilemmas of the new occupational classification

Polish research experiences point to the fact that the lack of a universal classification of occupations adjusted to the requirements of different users is a considerable obstacle to integration of knowledge on occupational stratification and the labour market situation. This is our opinion, even though the role of occupational classification in a centralized economy as an instrument in the decision-making process with regard to management of labour was highly limited. We think, however, that in conditions of a new system, in an economy where market mechanisms prevail, importance of information concerning occupational structure of the population, on outlines in vocational education, on projected employment opportunities in occupations, will become much greater. Consequently, the role and importance of occupational classification should also increase.

Even now, in the period of system transformation, we feel that users of labour market statistics have thoroughly changed their requirements, we indeed see the need to modernize the system of information on the labour market and methods of data collecting. New economic instruments introduced into Polish realities also increased the importance of statistics as a tool in economic decision-making. At the same time, new phenomena have occurred (such as official unemployment), which calls for expansion of labour market statistics. Transformation of the economy from a centralized into a market-oriented one also has its impact on changing expectations as to worker's qualifications. Practical experience and skills connected with the scope of activity now rate much higher than formal qualifications. A worker is expected to display certain flexibility in adjusting himself to new conditions and show ability to comprehend new techniques and technologies as well.

Nearly all the events on the labour market have their occupational dimension, what in considerable ways boosts the importance of occupational classification, as well as expectations connected with it. Thus, it is clear that the existing classifications of occupations, specializations, and jobs hardly meets the needs of the new economic and social realities. So, it is a pressing and urgent task to prepare a modern occupational classification, well suited to the new conditions. Work to this end in Poland has been underway for some time already at the Institute of Labour and Social Affairs. We sincerely hope that this work will be finalized soon, although one should take into account the fact that it will not be the ultimate version of the classification yet. For we are aware how complex this work is due to the need of applying a completely different methodological approach than before in constructing such a classification, as well as the need of taking the specifics of Polish socio-economic conditions into account. That complexity stems also from a desire to have an occupational classification of a very broad and universal application.

We assume that the new occupational classification should be applicable at least in the following four areas:

- Statistical surveys,
- Labour market analysis,
- Vocational education policies, and
- Social (sociological) research.

From the point of view of the interests voiced by the Central Statistical Office, particular emphasis should be put on applicability of the new occupational classification to statistical surveys and labour market analysis. As regards statistical surveys one can identify three major areas of its application:

- Population censuses,
- Labour force survey conducted in Poland since May 1992, and
- Employment and earnings survey according to occupations, which we intend to commence in 1994.

As regards the analysis of the labour market and employment policies the occupational classification is an inevitable tool within the system of information on the labour market, which we plan to create in cooperation with BLS. We assume that information on occupations would be used in surveys and analysis on both the demand and supply of labour. For these reasons it seems highly important that occupational classification be introduced to the work of local labour offices (employment agencies, occupational counselling, educational programmes), and personnel sections at establishments

(schedules, balancing personnel needs according to occupations), as well as to forecast demand for labour.

The question of estimating the adjustment of labour demand and supply by occupations, as well as of determining projected demand for labour according to occupation is connected with specific tasks in the area of vocational education, occupational reorientation, and providing the possibilities of career choices. All these tasks at present are performed in a manner inconsistent with economic needs and social expectations. Without the implementation of new occupational classification it is impossible to undertake rational activities in the sphere of vocational education policies.

The applicability of occupational classification to sociological research should not be overlooked either, as such research performs a very positive diagnostic and cognitive function with regard to social changes. We believe that in this period of fundamental transformations within the system in Poland such studies and estimates will only grow in importance.

Thus, the occupational classification has to fulfill many important functions. It should be able to match the needs of employers and employees, specify similarities and differencies among occupations, conduct diagnostic studies with regard to occupational demands of the economy, and outline the activities of vocational education. It should therefore fulfill a number of conditions which would enable and facilitate practical application of the classification in such a wide-ranging practice. Let us mention just a few major ones.

1. The new occupational classification, first and foremost, should be so universal in nature as to become the basis for preparation of more synthetic classifications (of socio-occupational groups), applicable in various studies and surveys.
2. It should also be an open classification, that is, one able to adjust to changing conditions and needs. This feature is particularly important in the situation of Poland. In spite of the fact that this classification is being prepared in conditions of an unstable economy, it should not have a provisional character, so it should operate in an unchanged general shape for at least a dozen or so years. Over such a period of time one should take account of the fact that some new occupations might appear and some old ones vanish. This is why its construction should be made flexible.
3. Due to the need of using occupational classification for the purposes of vocational education, it should provide the possibility of describing not only the occupation performed but acquired as well, the one linked with qualifications received in the course of school studies or in-work practical training.
4. It should also allow for depicting current employment structures, in keeping with the needs of the present and prospective realities. Due to specifics of the situation in Poland this has a major practical importance, and could be decisive of the classification's actual usefulness. As an example of the mentioned specifics, let us just quote the need to differentiate in the occupational classification a group of individual farmers.
5. The new classification should also be constructed in such a way so as to guarantee continuity of information with results of earlier statistical surveys. It would be hard to accept a classification which would not allow for analysis of time series nor appreciation of changes occurring over a longer period of time. The more so, that statistical and sociological research have supplied considerable empirical data on hitherto social changes in Poland.
6. The authors of a new classification should strive to give it high clarity and ease of practical application. It is the more important since the classification is designed to be used also by local employment offices and establishments. We firmly believe that a dictionary of occupational titles describing activities characteristic of concrete occupations should become an integral part of the classification.
7. The features mentioned above are connected with the question on the extent to which the classification should be detailed. There are two trends competing in the on-going disputes today. The first assumes that the classification should include as many individually coded occupational specializations as possible; the second, that the basic classification should limit them to the necessary minimum and find their elaboration only in a descriptive part provided for the purpose of facilitating the use of the classification (in form of a dictionary or index). The latter one assumes that an overdetailed classification is not flexible enough and as such is difficult in practical application. Past experience indicates that classifications are usually used up to the level of unit groups.
8. As Poland becomes ever more involved in the European and world economic systems, the question of international comparability of data, in other words, the cohesion of Polish occupational classification with international classifications, becomes ever more important. This calls for adoption of the same principles on which international classification was constructed or for elaboration of the Polish classification in such a way so as to provide for the possibility of its remaking in keeping with recommendations of international statistics.

In the light of the above mentioned characteristics of the new occupational classification, it seems quite obvious that its preparation is indeed a tough and responsible job. Consequently, we assume the need of consulting initial results of these efforts with foreign experts, especially with regard to practical applicability of the classification to statistical surveys. We count on positive results, the more so that the general concept of the Polish classification follows the lines of the international classification ISCO 88 by adjusting it to Polish conditions and specifics. To some extent a simplified ISCO 88 classification is in use even today, being applied in labour force surveys and statistical reports of local labour offices. This fact reaffirms the great demand for a new occupational classification on the part of statistics and practice, one that would respond to the changed social and economic environment and to the expectations of users.

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The United Kingdom's Standard Occupational Classification

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Background to the development of SOC

The United Kingdom's Standard Occupational Classification was designed to replace two earlier classifications, the Classification of Occupations and Dictionary of Occupational Titles (CODOT) and the 1980 version of the Classification of Occupations (CO80).

CODOT, published in 1972 by the Department of Employment, was used in job placement and vocational guidance, and as a basis for labour market statistics. Much work went into producing detailed lists of tasks and job titles associated with each group.

The "Key list of occupations for statistical purposes," (KOS) which contained 404 occupational categories, mapped directly into the 18 CODOT major groups.

Developed from earlier classifications in this series, CO80 was used by the Office of Population, Censuses and Surveys to code occupational information on Census of Population forms and in many other applications.

During its development there was pressure from the Employment Departments to bring the system used by OPCS into line with KOS. After detailed discussions on the viability of specific categories, OPCS agreed to make some new distinctions.

Although not able to recognise all KOS categories, the CO80 unit groups were aggregated into the 161 categories of condensed KOS which was designed to be a bridge between the two classifications.

In practice, the attempted assimilation did not work well and worsened the discontinuity between CO80 and its predecessor CO70.

In the mid 1980's, the Manpower Services Commission (MSC) which was then the custodian of CODOT, decided it was time to revise the classification. This coincided with plans by OPCS to revise CO80, and it was agreed that a classification to be known as the Standard Occupational Classification should replace CO80 and CODOT to provide a common structure and method of classifying occupations for use in government.

The technical development work was contracted out to the Institute for Employment Research (IER) at the University of Warwick. The IER team worked with staff from OPCS and the Employment Service.

The development of the new classification was overseen by a steering group chaired by the Training Agency, as successor to MSC, with representatives from OPCS, the Central Statistical Office, and other parts of the Employment Departments.

The International Standard Classification of Occupations (ISCO) was also being revised, so the SOC development team took the opportunity to consult with the ISCO revision team to achieve the closest feasible harmonisation between SOC and the new international standard ISCO88.

Aims in the development of SOC

The SOC development team pursued a number of aims. The main objective was to group together occupations (by reference to job titles) which are deemed similar when taking account of two criteria, the level of skill, experience, or formal qualifications required to carry out the work competently, and the nature of the tasks performed.

These are not new criteria, but in SOC an attempt was made to apply them consistently throughout the classification.

Other significant criteria were,

- Drawing new and useful distinctions between types and levels of work in fast developing and economically important areas of work such as computing and information technology.
- Differentiating between types of work which are mainly done by women such as nursing, teaching, and clerical work.
- Reducing the high proportion of jobs previously allocated to residual "Not elsewhere classified" coding groups. Such groups typically contain jobs with different types of activity and requiring different levels of skill.
- Achieving an up-to-date structure of occupations but at the same time preserving a degree of continuity.
- Designing a classification which is practical and reliable for applications such as job placement, vocational guidance, and when coding job titles and descriptions from sources such as censuses, surveys, and vital registration records.
- Aligning with ISCO as far as possible to achieve the maximum practical level of compatibility.

The format of the classification and numbering system is hierarchical to give different levels of aggregation for various analytical purposes. Initially, three levels were

planned, but, following the development of ISCO, the sub-major level was introduced.

Method of development—SOC structure

The starting point for designing SOC was adapting the 350 operational coding groups in CO80 to meet the SOC development criteria.

The proposals for subdividing or redefining the operational coding groups were tested for feasibility. This was done mainly by reference to a 0.5 percent sample of responses to questions on occupation, employment status, industry, and qualifications in the 1981 Census of Population.

This sample, which included verbatim responses and occupation codes, was produced and held at OPCS.

Another key source, provided by the Employment Service, was the description of approximately 5 percent of job vacancies notified annually to job centres. This was more up-to-date than the OPCS sample but was not as fully representative of all types of jobs.

Each proposed change was considered by reference to the 0.5-percent sample records. This was to see if it would successfully separate jobs into distinct occupational categories and that coders, following set rules, would consistently make the separation. Where it was found that the proposal would not work it was abandoned or modified.

A number of distinctions in CO80 were dropped, particularly among machine operative, assembling, and labouring occupations.

SOC coding index. The main basis of the SOC coding index was the one in CO80. New job titles had to be added and those carried forward from previous indexes, which had become redundant, removed.

In the past index revision was an entirely manual task, but for SOC this process was aided by work done at the University of Cambridge by Dr. Ken Prandy who had independently compiled a machine-readable concordance of indexes from CO60, CO70, CO80, and CODOT.

Field testing and consultation

Before the SOC structure was completed, the reactions of potential users were sought. The Employment Service held field tests in selected Job Centres and OPCS set up a consultative group of representatives of CO80 users. The Training Agency invited comments from bodies such as industry training boards, employment associations, and trade unions.

Employment Service users and the special interest representatives raised about 120 different criticisms and suggestions. These were reviewed and about half were accepted and incorporated into revised versions of SOC.

The OPCS consultative group had some worries about the feasibility of some of the new distinctions, especially if these could be made with, for example, the limited occupational descriptions on death certificates. The distinctions in SOC take the middle path between the most and least detail available in the sources of raw data.

The consultative group welcomed the summary levels of SOC and wanted to see the existing social classifications, social class, and socio-economic groups, re-based on SOC with the minimum discontinuity.

The group was also pleased with the OPCS proposals to use a coding frame with more categories than SOC unit groups when processing the 1991 Census of Population. This coding frame of component codes preserves distinctions required by CO80 as well as those required by SOC.

The SOC volumes

SOC volumes 1 and 2 were published together in February 1990. Volume 1 contains sections on,

- The principles, concepts and conventions of the classification.
- The treatment of some technical problems in the classification of occupations.
- The detailed structure of unit, minor, sub-major and major groups.

The main part of the book describes each unit group, listing typical tasks carried out and common job titles classified to the group.

Volume 2 contains an index of approximately 23,000 job titles with a description of how to use the index and some notes on coding.

Volume 3, which was published in May 1991, gives an account of the main changes and discontinuities between CO80 and SOC, and describes how the summary social classifications can be derived from SOC.

Introducing SOC

The majority of tables on occupational data from the 1991 Census of Population use SOC, but a few are based on CO80. It will be possible to order commissioned tables on either classification. No results will be published on the component coding frame because the component codes have no significance in their own right.

SOC has been introduced into other major government sources of statistical information on occupation.

The 1991 Labour Force Survey used the component coding frame to allow users to link the 1991 results both to earlier years and future years. Subsequently, coding has moved to SOC unit groups.

The Department of Employment's New Earnings Survey introduced SOC with the presentation of the 1991 results. The 1990 occupational information was recoded to SOC as well as being coded to the previous KOS system.

SOC has been in use for managing information on Employment Training and Youth Training since April 1990, and the Employment Service introduced SOC into

all its local offices in April 1992 to classify job vacancies and the occupation of clients claiming benefits.

SOC support and maintenance

Discussions between OPCS and the Employment Departments led to the decision that a small team in OPCS, the Occupational Information Unit (OIU) would undertake support and maintenance of SOC. An interdepartmental board, the Standard Occupational Classification Management Board (SOCMB) was also established.

Initially chaired by the Central Statistical Office, the chairmanship of SOCMB now alternates annually between the Department of Employment and OPCS.

The OIU, although formally established in May 1990, when the manager was appointed, started its service in December 1989. It provides advice to SOC users, recording their queries and comments. Its other functions include,

- Assisting with training of occupation coders.
- Keeping in touch with developments in occupation classification (including computer assisted and automatic methods of coding).
- Capturing and storing comments and answers from Census coding and other major SOC applications in OPCS, the Employment Group, and elsewhere.
- Keeping under review the case for revision of the classification and organising reviews.

SOC revision policy

During the development of SOC and consultation with users it was argued by some that decennial revision is too infrequent, and there was some support for thorough reviews every 5 years. A revision policy needs to strike a compromise between keeping fully up-to-date and with indefinite preservation of an apparently constant structure. Those concerned with statistical comparison over time argue for a conservative revision policy whereas client-oriented users place a high premium on being up-to-date.

In May 1992 the SOCMB decided to keep the decennial cycle for revision to the structure of SOC but recommended updating the index of job titles every 5 years. For this index updating process, the OIU staff will use all the query information which they collect plus two other major sources of data.

During occupation coding of the 1991 Census of Population, a large number of queries were raised by the coders. When the coding process was completed, the 175,000 query slips were sorted into alphabetical order of basic job title to aid further analysis.

The other source of information will be the 1991 Census 0.5-percent sample. Having drawn the sample of records into a separate database, the relevant census forms are being extracted from their boxes for the written answers to questions on occupation, industry, and qualifications to be keyed. This text is being merged with the coded records. By the end of this year the merging process will be complete and we will have in place the system to interrogate the records.

In conclusion

The first Standard Occupational Classification for the United Kingdom has been successfully introduced and a small team to support its users has been established.

Appendix. Glossary of Terms and Abbreviations

Institutions

OPCS Office of Population Censuses and Surveys

Government department responsible for carrying out censuses of population, registration of births, marriages and deaths, a range of sample surveys, and other functions involving classification of occupations. Sponsored with ED and participated in the development of SOC and has responsibility under an Interdepartmental Management Board for maintaining SOC.

ED Employment Group of Departments

Responsible for implementing government employment, training, and manpower policies and for producing a range of statistics concerning the labour force and its attributes, including occupation. Sponsored the development of CODOT and now SOC, and with OPCS is one of the two main government users of SOC.

IER Institute for Employment Research
University of Warwick

Collaborated with OPCS and ED to develop SOC.

Occupational Classifications and Classificatory Terms

CO80 OPCS Classification of Occupations, 1980

This was used in classifying occupational information obtained via the 1980 Census of Population, and has been used in many survey and other applications during the 1980's. Its predecessor was the Classification of Occupations, 1970; its successor is the Standard Occupational Classification (SOC).

OCG Operational Coding Group

One of the 350 most detailed categories into which job titles and activities were coded in the 1981 Census, using the Classification of Occupations 1980 (CO80). The detailed occupation classification used in analysing census data was an elaboration of this.

CODOT Classification of Occupations and Directory of Occupational Titles

This is the classification used in many Employment Departments and other applications until replaced by the Standard Occupational Classification. It was designed to provide a high level of detail suitable for distinguishing skill specialisms and for use in job placement etc.

KOS Key Occupations for Statistics

This is a classification obtained by aggregating the categories of CODOT to provide a detailed occupational breakdown suitable for statistical work. It has been used in coding occupational information from large sample sources such as the New Earnings Survey.

Condensed KOS

This was created by further aggregation of the KOS categories. It could be matched by aggregation of categories distinguished in CO80 and thus provided a "bridge" between the two approaches to occupational classification represented by CODOT and CO80. It has been widely used in presenting occupational statistics.

SOC Standard Occupational Classification

OUG Occupational Unit Group

One of the 371 most detailed categories into which job titles and activities are coded using SOC.

Minor Group

One of 77 categories into which the 371 Occupational Unit Groups may fall. Can be aggregated in SOC.

Sub-major Group

One of 22 categories into which the 371 Occupational Unit Groups may fall. Can be aggregated in SOC.

Major Group

One of 9 categories into which the 77 Minor Group Groups can be placed. Aggregated in SOC.

ISCO 88 International Standard Classification of Occupations, 1988

Classification of Occupations developed by the International Labour Office (ILO). Revised in 1988. Similar structure and level of detail in SOC, but with some important differences of detail.

Socio-Economic Classifications

SC Social Class based on Occupation (formerly Registrar General's Social Class)

Scale for classifying persons into one of six groups. Developed and maintained by OPCS and its predecessor and widely used in censuses, surveys, and other research. Derived by grouping occupational categories and making further discriminations by reference to the job-holder's status in employment (self-employed, supervisor, etc.). Now based on SOC.

SEG Socio-Economic Groups

Classification of persons into 1 of 17 groups taking account of occupation, status in employment, and size of employing establishment. Widely used in censuses and surveys. Now based on SOC.

Major Official Sources of Occupational Data

Census National Census of Population

Carried out every 10 years throughout the United Kingdom (last in 1991, next in 2001). Collects social and economic information about all members of the population, but occupation and other items are coded and analysed for a 10-percent sample only.

LFS Labour Force Survey

Large annual household survey carried out in Great Britain by OPCS on behalf of the Employment Department since 1973. Collects information about many attributes of household members, particularly those related to labour force participation (for example, occupation).

NES New Earnings Survey

Large annual survey carried out by the Employment Department. It is based on a sample of employees identified through their National Insurance numbers, and collects information about them, including occupation and earnings, from their employers.

The Role of the OPCS Occupational Information Unit

The Occupational Information Unit has been set up within OPCS to support users of SOC. It provides a central point for advice and information on coding occupations and has responsibility for updating and revising SOC. Staff of the unit log comments and queries arising from census coding and other major SOC applications in OPCS, the Employment Group of Departments, and elsewhere. The unit keeps in touch with developments in occupational classification, including computer assisted methods and changes in occupational terminology.

The address of the Occupational Information Unit is:
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Developing an Occupational Classification System for the European Community: Efforts to Harmonize National Systems

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In this presentation I will be wearing two hats. For the first part of my talk I will be describing work that we are undertaking within and around the European Community, funded by the Commission of the European Communities. Wearing my second hat, as an independent researcher at Warwick University, I thought it would be quite useful to give some tips or hints about developing occupational classification, which I draw from the experience of designing and helping with the implementation of occupational classifications in a few countries and as an observer of this process in many other countries. On the basis of this experience I have put together some points. Some will be tongue-in-cheek, others will be most serious—and I am not going to tell you which is which.

I shall start by describing work that we have been undertaking on behalf of the Commission of the European Communities, to implement a classification which will help us to communicate information on occupational structure, occupational trends and tendencies between the various countries of the European Community. This is obviously important, as the mobility of labour between the countries of the European Community increases.

We now almost have in place a Community-wide employment service, exchanging information between countries about jobs. There are nine official languages in use within the European Community, so the exchange of information on occupational structure and on jobs presents considerable problems of translation. However, the main problems are not concerned with translation difficulties. Our principal task has been to ensure that the "building-blocks" of occupational structure, the way in which countries define groups of occupations as similar in certain respects, are the same between countries. Additionally, all of the National Statistical Institutes of the European Community now receive a substantial amount of their funding from the Commission of the European Communities. Amongst other activities, these resources help to conduct surveys within their own countries, surveys which generate information which conforms to standard definitions across each country of the Community. It helps with data processing in other ways and, as is the case with the work we perform for the Community, with the structure of classifications. Each National Statistical Institute is now much more closely integrated with the European Statistical Office than was ever the case, and this is, of course, going to increase. We need, therefore, to have a common language of occupation. There is only one common currency in this area—that is the International Standard Classification of Occupations (ISCO–88).

At the time that ISCO–88 was formulated during the mid-1980s, then adopted at the 14th Conference of Labour Statisticians, nobody quite realized just how important ISCO was going to be. Soon it was to become the vehicle for the exchange of information throughout the European Community, and, of course, with the subsequent developments in East and Central Europe and the potential enlargement of the Community, it has become the model through which the whole of Europe will be communicating information about occupations.

ISCO–88 is not the perfect vehicle for communicating occupational information between countries. ISCO–88 was designed in the office in Geneva with much help, obviously, from Australia, from Canada and from the United Kingdom to some extent. However, ISCO had to be a "framework" classification for all countries—not just to the European Community. So there was much discussion about the need to identify a wide variety of agricultural occupations, the need to identify occupations in the informal sector, and the need for certain other distinctions which are not particularly important within Western industrialized economies.

In addition, ISCO–88 indicates the *desirability* of identifying particular groups of occupations, not the *feasibility* of making such distinctions. ISCO–88 is not designed as an "off-the-shelf" occupational classification ready to be implemented. It is a structure, a guide, a framework, and it is up to others to take that framework and to make it work.

Within the European context we have a difficult problem, because each country has its own national occupational classification. Our first task in the project to develop a common classification for the European Community was to define the nature of the problem, to set up a strategy for implementing a common classification. The strategy we have adopted relies heavily upon the concept of secondary mapping—"crosswalking" from an existing classification to ISCO–88. In the course of this work we decided that ISCO–88 needed further clarification in certain areas.

At the second stage of this work, all of the National Statistical Institutes of the European Community agreed a variant form of ISCO–88, which is as close as possible in terms of upholding the principles underlying the construction of ISCO–88, but overcomes or attempts to overcome some the most difficult problems we have in implementation. By implementation I mean here the process of developing crosswalks between the national occupational classifications and ISCO–88 at its most detailed level. This led to the development of a variant that we call ISCO–88 (COM). ISCO–88 (COM) is now the European implementation of ISCO–88. We are currently at the stage of developing the cross-walks between the various national classifications and ISCO–88 (COM).

There are three main problem areas with ISCO–88. The first of these is the definition of the managerial group in ISCO–88, which distinguishes, on the one hand, between *corporate managers*, and on the other between *general managers*. These two levels of managers are defined in such a way that they delineate different types of authority, and the definition in ISCO is in terms of the number of subordinate managers that you work with in your organization: If you work with more than two managers you are a corporate manager. If you work with fewer than three other managers in your organization you are a general manager. I know of no statistical office or survey that collects information where they ask a respondent about how many other managers they work with at their place of work, because that raises difficult issues about, first, the definition of a place of work, and, second, what is meant by a manager? For these reasons the countries of the European Community have decided that the ISCO–88 distinction between *general* and *corporate* managers cannot be operationalized.

In ISCO–88 (COM), we have renamed one of these groups to move as close as possible to this distinction. Corporate managers stay the same. General managers we call "managers of small establishments." We draw a distinction between managers in establishments with 0 to 9 employees and managers in establishments with 10 or more employees. Thus our attempts to reach the best approximation to what ISCO is trying to do is to distinguish between the general management that takes place in small enterprises—where the manager is all things to all people—and the corporate manager, where training levels and educational requirements are higher, and there is usually a degree of specialization.

The biggest problem area of all has already been alluded to by Olivier Bertrand in his presentation. It is not specifically a French problem; it is a problem for all of the Community countries; and I would imagine it's also a problem here in the United States. This is the issue of public service occupations, or occupations within the public sector. These occupations have a language and a currency of their own. For example, among public service employees, one is not surprised to hear people using phrases like, "have you heard about so and so, she's been promoted to an SIC", or "have you heard of—, he's now G5,—how did he get to that position?" I am sure you know the relevant languages in the United States. It is the unique shorthand language in countries in terms of the reference to their public service occupations.

The French cut through all this by saying, we will have one category and call them public service occupations. It is as simple as that. It is a heterogeneous group, but in terms of their social status maybe not so heterogeneous.

How, then, do we take coding strucures which only identify particular types of public service occupations without the sort of skill specializations and skill levels that we need for ISCO? How do we take these and slot them into ISCO–88? The answer is, with great difficulty. This is something that's been occupying us for a couple of years now, and we have yet to evaluate the result.

A final area where we modified ISCO is in the area of agricultural occupations, but these are not particularly significant deviations.

So, the question now is, when will we have some information that enables us to compare occupational structures between countries and to decide whether these are meaningful differences between countries or whether they still represent problems of occupational classification? Table 1 shows the current status of our work on the development of "crosswalk" tables and lists the availability of occupational data from Census of Population and Labour Force Survey sources.

Table 1. Harmonisation of European Community occupational classifications ISCO–88 (COM)

Country	Availability of ISCO-88 (COM) data		
	"Crosswalk" tables available	Labour Force Survey	Census of population
Belgium	2/93	2/93	4/94
Denmark	n.a.	12/92	after '94 census
France	12/92	12/92	12/92
Germany	11/92	6/93	n.a.
Greece	3/93	4/94	11/93
Ireland	10/93	6/94	9/93
Italy	n.a.	4/93	10/93
Luxembourg	n.a.	4/93	12/92
Netherlands	12/92	3/93	12/92
Portugal	3/93	3/93	6/93
Spain	11/92	12/92	12/93
United Kingdom	1/93	3/93	1/94

n.a. = not applicable.

I would now like to describe our current program of work. We have five tasks in this year's work program. The first one is that the European Community Statistical Office has asked us to prepare a user-orientated guide to ISCO–88 (COM). This means a document that makes

it understandable to people who want to use occupational information on a community-wide basis.

We have to translate ISCO–88 (COM) into the nine languages of the Community. This is no mean task, because, of course, it's not a simple case of translation. We must convey the true meaning of the content of these occupational categories to someone who is reading this in their native language.

Our third task is to publish the crosswalk tables I mentioned earlier.

We must analyze occupational differences across the Community using Labour Force Survey data. The Labour Force Survey is the main Community instrument through which we collect information on employment and unemployment, job search activities, et cetera, within the European Community. This is funded in part by national governments and in part by the European Community. Such analyses will indicate the areas in which we must exercise caution in making comparative studies of occupational structure.

And, finally, we have been asked to give specific technical assistance to Greece.

I'm now going to go on to talk about the work which we are doing for the European Community outside of the Community but, again, funded by the Community, in East and Central Europe. This is the most difficult phase of this work that we've now entered.

Very briefly, the agencies concerned in this effort are the World Bank, the European Community and some country-specific technical aid (for example, Japan and the U.K. Know How Fund). The programs that are leading to the development of work on occupational classification are either labour market information systems programs (this is the approach that the World Bank has taken in Romania, for example) or they are viewed as statistical programs—this is the way the European Community views its interventions. There is a special role for the European Community Statistical Office as the overall coordinator of all external statistical aid agencies. We are the main contractor to provide the technical assistance in the area of classification of occupations.

This list of countries which are receiving, or have been offered, technical assistance gets longer every week. There are some countries not on the list yet, because, for political reasons, they have not yet entered technical assistance programmes. This is the case in Bosnia. But, there are other countries which are already knocking on the door of the Community and are in a highly advanced state. This is the case for Poland and Hungary. These two countries have a very strong tradition of good statistical work and a history of classification. They are already moving to modify their classifications and align themselves with Community standards. It won't be long before they have full implementations of the European Community standards in these areas.

Other countries have not yet started. Russia, particularly, is very far behind in this area, not surprisingly. But the Romanians have just completed work on the definition of their new occupational classification, which is based on ISCO–88 (COM).

So what kind of technical assistance is provided? We have organized this into four levels of assistance: Definition of a new classification; assistance with implementation of classification within a statistical context; maintaining and updating an existing classification; and providing computer-aided systems for occupational classification. Essentially, we invite countries to shop from this list, choosing among these four levels of service. These are provided mainly through three types of activities: Training; user-friendly documentation; and workshops, like this one, but in a more interactive setting, held at Warwick in the fall of each year.

Now, wearing my "personal" hat, I would like to take 5 minutes to try to distil some tips from all of this work, which may be relevant to the tasks now getting underway here on DOT and SOC. And, as I said, some of these are a little tongue-in-cheek.

My first tip, and this might surprise you somewhat, is do not spend too much money. In this area, activities expand to fill the resources available. It is a bottomless pit, and you must determine how much work you are going to do, first by establishing the budgets for this activity, not the other way around. In my experience, it appears that in all of the work done in various countries on occupational classification, whether it is the production of an SOC, or an equivalent of DOT, there seems to be an inverse relationship between the amount of money spent and the quality of the result achieved. The best example of all which I commend to you comes from the Central Statistical Office of Ireland. In my work for the Community, I went over to Ireland about 3 years ago on behalf of the Community. I knew they had an outdated occupational classification. They sat and listened to me and looked at ISCO-88, shook their heads, puzzled over it, asked me, "Didn't you do the U.K. Standard Occupational Classification?" On affirming this, they outlined their plan to introduce a variant of the new U.K. classification in Ireland. Of course, they have done a lot of work on the development of a very good index to the classification, and the task of implementing a classification is no easy business, but the structure they took off the peg.

The point I am making is, if you are going to pull the occupational classification apart and rebuild it, you will spend a lot of money and resources, and I do not advise that.

A second point, do not attempt to do everything this time round. Establish a long-run program for these activities. This is not a project, this is a programmatic. It must be viewed as a long-term activity. At times, the pace of activity might be beefed up to get something

published by a particular date, or to make sure that a particular structure is in place, ready for a census or a survey or whatever, but it is essential to maintain this work on a long-term basis.

Third, make sure you establish criteria for the classification, publish them and be prepared to ignore them. Everybody else does!

Fourth, do establish a classification development committee, mainly on the producer side, but one which can consult with users. In most countries there are two main groups working on the producer side, a Ministry of Labour or Department of Employment on the one hand, and a census office and statistical offices on the other, and these groups have to come together. Here, of course, it's the producers of DOT and the producers of SOC who have to come together. You may invite other people to join the classification development committee, but do not expect them to help you.

Fifth, beware of specific occupational groups. They crawl out of the woodwork in the most unexpected fashion. Be ready for anything in this area, and have all your answers and your arguments well thought out in advance. We survived a prolonged attack in the United Kingdom by the librarians, but only by shifting their position in the classification in the final analysis. Currently we are engaged in a protracted dialogue with the florists!

Sixth, do take, seek, and expect advice from industry-based organizations. You might take it with a pinch of salt, but there is much good advice for the taking here. Let them do some of the work. They will be only too keen to help. Be very careful when they tell about fancy new names for jobs and occupations, that these names really do exist and they are not a figment of somebody's imagination. I'm afraid we have some such names in the structure of the United Kingdom Standard Occupational Classification, and we have yet to find evidence of anybody actually using these job titles.

Seventh, do not attempt to appease the academic community. Prepare for all out combat in this respect. You will never please academics. They will always pick holes in whatever criteria you establish for your classification. They will write academic papers pulling it apart.

Eight, do put resources and money into computer-automated coded, computer-assisted coding. I cannot stress this more. These are systems which give a tremendous amount of flexibility, they help to organize one's thinking about occupational classification, and they provide the base material that you need for index revision, for index development and for maintenance of the classification. Such systems are, in my opinion, now essential.

Nine, please make sure you put a lot of effort into the development of user-friendly guides. I am most encouraged by all the statements that have been made about the need to convey information on occupational classification and occupationally classified information in different formats, recognizing the variety of users, and the variety of media through which this information is going to be presented. One of the worst problems that we have with the British classification is when people phone up and say, "What does associate professional mean?" I think we failed, quite honestly, if we give major groups names like "associate professional", which fail to communicate the nature of the major group. Producing the right kind of documentation can overcome those problems.

And, finally, my last comment today. Believe in SOC. DOT may be the *Bible;* SOC is the Creed. One needs the other, but be driven by the SOC. Put your effort into the development of the SOC. Of course, DOT must be maintained. The U.S. DOT is one of the world's leading dictionaries of occupational titles, and it cannot be left to become increasingly outdated, but DOT is very expensive to maintain. Do not let the maintenance of DOT detract you from the much more important goal, in my opinion, of developing a common occupational classification for the interpretation and presentation of information on occupational trends, tendencies, and careers, throughout all of the United States.

Thank you very much.

The Standard Occupational Classification 1991: Statistical Considerations in Developing a Classification of Occupations

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Introduction

In Canada, the tradition of developing an occupational classification designed both for labour market program and policy application and for statistical purposes goes back to 1970. Before that Employment and Immigration Canada, the Department of Manpower and Immigration at the time, used the *U.S. Dictionary of Occupations* (DOT) and Statistics Canada, which was the Dominion Bureau of Statistics, used its own system of occupational groups for statistical purposes. In 1966, the Department of Manpower and Immigration undertook for the first time, a program of field research and analysis of jobs in Canada and in cooperation with the Dominion Bureau of Statistics, developed a classification of occupations called the *Canadian Classification and Dictionary of Occupations* (CCDO) consisting of a classification structure which distinguished 6,700 detailed occupations at a 7-digit level, grouped to 498 occupational groups at the four digit level. The CCDO was designed as a multi-purpose standard classification for use in manpower research and analysis, the conduct of surveys, the coding of census responses and the compilation of occupational statistics, planning of educational and training programs, counselling and placement services, rehabilitation, immigration, personnel and other operations in business and industry. The classification at the 4-digit, unit group level, with minor modifications, was implemented in the 1970 Census of Population, for which an Occupational Coding Manual was produced by Statistics Canada. The criterion used for the classification of jobs into occupations was "kind of work performed," which criterion had been the basis of the occupational classifications used by Statistics Canada in successive Censuses going back to 1911.

The CCDO was updated annually to include new occupations. Statistics Canada incorporated many of these changes into its revised 1980 Standard Occupational Classification (1980 SOC) and in the occupational coding manual used to produce occupational statistics from the 1981 Census of Population.

Before launching the latest revision of the occupational classification for 1991, Employment and Immigration Canada undertook a survey to gather information on the concerns, problems and preferences for change, of users of the classification. The grouping criteria most frequently requested by users were: Skill level, as measured by the technical or educational background required in order to obtain the job; kind of work performed; and skill level, as measured by the complexity or difficulty of the tasks the worker performs. Users who responded to the survey were almost equally divided between those that expressed a preference for a classification based on skill level and for one based on skill type or kind of work performed. There was general dissatisfaction with the level of heterogeneity of skill to be found in many of the groups of the classification.

In the 1991 revision of the occupational classification, Employment and Immigration Canada and Statistics Canada have produced an integrated occupational classification system, in the form of two classifications described as the National Occupational Classification and the Standard Occupational Classification 1991. The classification structures that have been developed for the integrated system, cater to the two requirements of a classification for labour market analysis, job placement and training programs based on skill level and a statistical classification based on kind of work performed, by providing two aggregations of a common set of unit and minor groups.

This paper discusses some of the statistical considerations that were brought to bear in developing the revised occupational classification, how they were brought to bear, and some issues that arise in creating an occupational classification suitable for the two main purposes.

Analysis of the 1980 SOC

While Employment and Immigration Canada, with some methodological assistance from Statistics Canada, undertook an extensive program of field research and industry studies of jobs and occupations in a wide range of goods producing and services producing industries, certain background research was undertaken by Statistics Canada that proved useful in the development of the revised classification.

The existing classification had been criticized by many users as being too heterogeneous. The users noted that at the aggregate level some aggregates had occupations that had greatly different educational requirements or greatly different renumeration levels and other differences that indicated heterogeneity. The detailed classes were not criticized as often and were generally thought to be homogeneous. A systematic review was undertaken to determine which unit groups were heterogeneous and why. This was accomplished by linking the unit groups of the 1980 SOC to their corresponding unit groups in the *Canadian Classification and Dictionary of Occupations* (CCDO). The CCDO graded, defined occupations at the 7-digit level of the classification, within a scale of 1 to 6 for the General Educational Development (GED) and 1 to 9 for the Specific Vocational Preparation (SVP) required for the jobs within the occupation. The ranges of GED and SVP within each unit group were used as an indicator of the heterogeneity of the unit group, if the contents of the group were sufficiently similar to the corresponding unit group in the 1980 SOC.

The review concluded that a large number of the unit groups were heterogeneous. These groups were identified along with the underlying reasons for the heterogeneity. Where possible, solutions were suggested that would result in new, more homogeneous unit groups that would also be of interest to users. For example it was suggested that Chefs be split from Cooks, each to be a unit group. Such a split would not only resolve the problem of heterogeneity but would result in new occupational classes that would be of interest for many analytical reasons. The labour market aspects on both the demand and supply side would be different. Cooks would be an occupation that was widely dispersed geographically whereas Chefs would be an occupation predominantly found either in large urban centres or resorts. Other aspects such as gender composition would also differ between the two groups. This split was done for the NOC and 1991 SOC.

The analysis of GED and SVP was undertaken, as it was information that pertained to the occupation rather than the incumbent of the job. This is an important consideration. Some analysis and manipulation of the unit groups had been attempted on the basis of the educational attainment characteristics of incumbents. Although cross classification of occupation by education is very informative about the incumbents, it is difficult to link to occupations. In the present labour market, many incumbents have educational attainment levels that exceed the entry level requirements of their occupations. Even groups known to be homogeneous as to the educational requirements of their constituent occupations will display a wide distribution of educational attainment levels for their incumbents.

Operational areas often do quantitative assessment of coding errors. Such studies can often be exploited in classification development. For example, a study about coding bias in the census of population was reformatted to produce a pairing of errors. The most significant pairs of errors were assumed to be the potential classes that might be the cause of confusion to coders. The study was undertaken to examine the relationships between these pairs, to look for plausible classification explanations and to produce suggestions for possible classification improvements. For example, problems between the unit groups 5193, Route Drivers, and 9175, Truck Drivers, was noted and a recommendation was made that the concept of route driver be examined. This was undertaken and route drivers were deemed not to be sales occupations and were included with a new unit group for delivery drivers in the NOC and 1991 SOC. The great difficulty with such studies is that it is often difficult to determine if the problem is with the classification or with the responses.

In order to undertake further analysis of the 1980 SOC, a large scientific sample of responses, data captured in machine readable form from both the Labour Force Survey, which is interviewer based, and the 1986 Census of Population, which is self-enumerated, was extracted. This sample was considered to be made up of typical responses and made it possible to undertake analyses of the existing classification that proved useful in determining some of the general strategies for future classification development. Perhaps the most significant was the analysis of the "not elsewhere classified" (nec) unit groups.

A criticism of the classification was that approximately 20 percent of the population of the labour force classified were found in these groups. These "not elsewhere classified" groups had occupations classified to them that did not fit into any other unit group within the minor group but definitely belonged to the minor group. They were also used as the mechanism for handling vague responses. Responses that were too vague to be coded to one of the other unit groups within the minor group but specific enough to be known to belong within the minor groups were coded to these "nec" unit groups. By examining the actual responses, it was possible to determine the proportion that were due to the actual occupations classified to the "nec" unit groups and those that were the result of vague responses. Furthermore, an examination of the vague responses sometimes showed patterns that had classification implications.

Often, a sufficient proportion of responses were found for a distinct occupation, that suggested the creation of new unit groups. For example, the analysis of the unit group 3169, Other Occupations, in Medicine and Health nec found that ultrasound technicians and veterinary assistants should be considered for further analysis as potential new unit groups within future classifications. These became unit groups in the NOC and 1991 SOC. It also found that pharmacy assistants made up close to 20 percent of this group although the title, pharmacy

assistant, was not found in the existing classification. It was suggested, that further research be done to determine if this warranted the creation of a unit group and that any future classification at least have example titles for this occupation. Although not a unit group, appropriate example titles for this occupation are found in the NOC and 1991 SOC.

Sometimes, an examination of the vague responses suggested that the problems were so serious as to suggest collapsing of other unit groups within the minor group. The best example of this is the study concerning the implementation of the unit group 7119, Farmers nec. This group contained occupations such as maple syrup farmers, christmas tree growers, and mixed farmers. The population for this group was almost double the population total for two other unit groups 7113, Livestock Farmers, and 7115, Crop Farmers. Census of agriculture figures for farm types suggested that most farms were either crop farms or livestock farms. The CCDO definitions for detailed occupations made it very clear that livestock farmers would also be engaged in growing crops such as hay or corn. Indeed, the growing of such crops is often an integral part of the operations of livestock farms. From an occupational point of view, it was obvious that many livestock farmers had to have the skills and equipment to engage in both crop and livestock growing tasks and that some crop farmers also engaged in some livestock farming. For farmers with livestock and crop farming combinations, the work performed could be mainly either livestock or crop farming tasks depending upon the season. Although on a yearly basis, the tasks associated with one specialty would probably prevail, it would require either special questions or type of farm data to resolve the question. An examination of the responses showed that it was the inability of the coder to distinguish between livestock and crop farmers that led to the majority of the coding to farmers nec. This, plus the complexity of the work performed and seasonality problems associated with many specialty farmers, led to the suggestion that since all farmers had so much in common, they be classified as one unit group in future classifications. This was done in the NOC and 1991 SOC.

An examination of the unit group 4199, Other Clerical and Related Occupations, nec was most productive. It was found that there were many possible occupations that could either be the basis of or become part of, new clerical unit groups. An examination of the coding error led to an examination of other clerical unit groups. It was found that a common response was clerk, followed by a list of tasks. The problem for coders was that it was necessary to recognize either the most important task or a distinct combination of tasks for proper coding of many of the clerical groups. A response of "clerk typing and filing" should be coded as a clerk typist following implementation rules, as typing was the first task listed. What was found was that coders trying to decide between either a "clerk typist" or "filing clerk" often opted either for "general office clerk" or clerk nec instead. The conclusion reached was that the classification could do without a "clerical nec" group, as the occupations within the group could either be the basis of new unit groups or incorporated into other unit groups and that a different mechanism could handle the vague responses. In the absence of strict procedural rules, it is expected that some vague responses will be coded to "general office clerks" but this is preferable to having such responses split between two groups. It was concluded that the coding of clerical occupations would generally benefit from more sophisticated coding procedural rules. The operational requirement for rapid coding limited greatly the viability of implementing such rules. To try to resolve this dilemma research is being undertaken into the possibility of using some form of computer assisted coding of occupations.

The study of the "not elsewhere classified" groups demonstrated the magnitude of the problem of vague responses being hidden in the populations of these groups. It was known that many users, when consulting the classification, would naturally assume that the populations of such classes represented the contents described in the classes. Thus a user might conclude that mixed farming, maple syrup farming and christmas tree growing were the most important farming occupations in Canada, although other more reliable data clearly indicated that this was not the case. It was clear by the magnitude of the vague response problem that the "not elsewhere classified" unit groups were often misleading as used and that a different mechanism of resolving the vague response problem was required.

Evaluation of the NOC Unit Groups

Employment and Immigration Canada, in cooperation with Statistics Canada, had the responsibility for developing a new occupational classification for Canada that was to be multifunctional in nature, including functioning as a statistical classification. EIC drafted a proposed set of unit groups for the revised classification based on their extensive field research. Statistics Canada evaluated the suitability of the proposed National Occupational Classification as a statistical classification. On the basis of this evaluation a common set of unit groups was agreed upon.

Classifications can only be implemented when the responses being coded to the classification provide the information required to make the distinctions made in the classification. The information available from the responses is determined largely by the survey methods used including the questions asked to elicit the responses.

Occupational classifications can be implemented through household surveys such as a census of population or a labour force survey. They can also be implemented

through surveys targeted to employers. Household surveys may be mail out/mail back surveys in which the respondent is provided with some written instructions and examples, or interviewer based surveys in which the interviewer can prompt the respondent to provide precise answers. Household surveys and some of the problems associated with them, such as proxy reporting, place a restraint on the amount of detail about occupations that can be collected.

As the proposed unit groups were to be implemented in the 1991 Census of Population and there was no possibility of adding to the number of questions nor of changing the questions, as the responses were to be coded both to the 1980 SOC and subsequently to the new 1991 SOC, this was a constraint on the nature of classification distinctions that could be implemented, and therefore on the classification itself. For example, if the questions generally elicited a response of "welder" to the question on the kind of work performed, it was not possible to implement a classification distinction based on skill level that differentiated between welders and skilled welders. Similarly it was not possible to implement certain proposed classes based on distinctions related to the type of machine used, when the typical response did not describe the kind of work performed with reference to the type of machine operated and there was no possibility of asking additional questions.

All proposed unit groups were tested as to their codeability using the large sample of data captured responses. It is important to note that the procedure was not merely to accept or reject groups but was also significant for refining the content of the groups. It may seem that a definition of the unit group boundaries are sufficiently clear but when attempting to implement the group as part of a classification questions may arise. As part of the evaluation of proposed unit groups such problems were forwarded to EIC either as a statement that there was confusion between two or more specific classes or as a question as to whether a specific occupation was included in a unit group.

In some instances, very specific problems with coding, that would require special edits to effectively correct, were discovered. For example, the initial proposal for firefighters excluded airport firefighters and industrial firefighters. This would have required an industry edit to code, as the typical response by firefighters did not provide this information. The problem was resolved by removing the restriction with little impact on the integrity of the group. It should be stressed that the rejection of a group did not require the removal of the groups from the NOC. In certain cases, EIC has chosen to keep the non codeable groups and to show the collapse to the statistical unit group by the provision of a special code. In most cases the rejected groups were clean splits of the present unit groups. For example, it was proposed to divide high school teachers according to the subject matter taught. Although this could not be done in the SOC 1991 and it is not in the NOC, there is a certain amount of flexibility for creating these groups in the way of sub groups, if it becomes clear that they are required in the future. Groups presently not implementable by the Census of Population and other household surveys might be implementable in the future if substantive changes are made to the questions asked on these surveys or special surveys are undertaken. One possibility is to use the existing survey results for selected unit groups as a frame and to ask additional customized questions specifically designed to achieve the required sub unit group data. For example, high school teachers might be asked what subject they taught. This general strategy was used by Statistics Canada in 1973 for the Highly Qualified Manpower Survey. The 1971 Census was used as a frame. Individuals with a university degree were identified on the census and sent a further questionnaire to obtain detailed information on their work, occupation, and education.

Another important consideration was that the proposed unit groups be of suitable size for statistical reliability. Research undertaken by Statistics Canada indicated that the minimum population required for reliability was approximately 1,000. To estimate the potential size for each proposed unit group the sample of responses mentioned above was used. By searching for responses that would be coded to the new proposed groups, a defacto trial coding of the groups was achieved. By blowing up the number coded to the group by the proper factor, a population estimate for the group could be achieved. In some cases, classes were rejected where it was felt that the population was indeed too small. In cases where the estimates were doubted, the classes were kept and tested for viability in a census test.

Aggregations for a statistical classification

An examination with population distributions showed that the skill level based major groups proposed by EIC had an extremely uneven population distribution. Statistics Canada desired a set of major groups that featured a more even population distribution, with a sufficient population in each, so that sample surveys other than the Census of Population could maximize the occupational detail available from these standard aggregates and at the same time the Census would have a set of standard aggregates that allowed a maximization of cross classification possibilities. Aside from the population distribution, these groups were designed to offer analytical flexibility, that had been somewhat inhibited by the strict skill level criterion of the EIC groups, in areas known to be of interest to users.

Tables 1 and 2 list the major groups of the two classifications, the NOC and the SOC 1991. A good example of the different treatment of major groups is found in the different disaggregation of the broad occupational cat-

egory—Sales and Service Occupations. The skill level approach resulted in a disaggregation into the three major groups: Skilled Sales and Service Occupations, Intermediate Sales and Service Occupations, and Elemental Sales and Service Occupations. A very large proportion of the Canadian labour force is in this category and a breakout into only three groups resulted in major groups with extremely large populations. Furthermore, the aggregations bury certain occupational characteristics within the group that are of interest to users. For example, police officers are combined with barbers and hairstylists in Skilled Sales and Service Occupations. This combined an occupation with a certain gender and visible minority sensitivity with an occupation that does not have such a sensitivity. Furthermore, police officers have working environments that have certain risk characteristics and work requirements, such as shift work, that are not shared by barbers and hairstylists. In this case, combining police officers with firefighters, correctional officers, security guards, and similar occupations that provide a protective service, resulted in a combination that, although not as homogeneous by skill level, was more homogeneous by other factors also of interest to many users.

The large population of this category allowed the creation of the nine major groups: Sales and Service Supervisors; Wholesale, Technical, Insurance, and Real Estate Sales Specialists and Retail, Wholesale, and Grain Buyers; Retail Salespersons and Sales Clerks; Cashiers; Chefs and Cooks; Occupations in Food and Beverage Services; Occupations in Protective Services; Occupations in Travel and Accommodation including Attendants in Recreation and Sport; Childcare and Home Support Workers; and Sales and Service Occupations N.E.C.

These groups all have sufficiently large populations and the distribution is fairly equal, although Retail Sales Persons and Sales Clerks have a very large population compared to the others and cannot be broken out any further as it is in fact a major group, minor group, and unit group. It also serves as a good example of a group that has many analytical merits. It is one of the largest single occupations held by women and by part-time workers. It has seasonal aspects and was greatly affected by such topical concerns such as cross border shopping. It is widely dispersed geographically and offers employment opportunities for students. Throughout, the major group structure created for the SOC 1991 has been designed to facilitate analysis concerned with gender, proprietorship, part-time work, etc.; as well as maintaining a minimum population of about 100,000 persons to facilitate requirements such as small area data availability.

Since many of the 1991 SOC major groups are simple splits of the NOC major groups, the resulting loss of skill homogeneity has been minimized. Many of these splits accentuated certain analytical requirements found within the same skill level. For example, splitting Clerical Supervisors from Clerical Occupations facilitates certain gender and employment equity analysis. In total, 36 of the 47 SOC major groups are equally as homogeneous by skill level, as the NOC major groups.

Adaptations for the Integration of the SOC 1991 and the NOC

The integrated structure shares the 10 Broad Occupational Categories to be found at the highest level of the two classifications. The major groups of the NOC group the occupations in each broad category into two or three skill levels under each category, resulting in 26 major groups. The 47 major groups of the SOC 1991 are under the same broad categories providing an alternative set of aggregations to meet certain statistical and analytical considerations previously described. The only adaptations to the proposed NOC structure required to facilitate the alternative major groups was the splitting of a few minor groups. The two classifications use the same minor groups and unit groups with the exception that 16 of the NOC unit groups that were necessary for the NOC but could not be implemented in the census, have been collapsed into 8 unit groups in the SOC. These collapses plus an indication of where the collapsed group will be found in the SOC, are shown in the NOC. It is not, in fact, surprising that at the unit and minor group levels it was possible to create groups that met both the criterion of the kind of work performed and of skill level. It is natural, because the nature of the work performed as reflected in the main tasks and duties of an occupation determines the education, training, experience or inherent talents required.

The numbering system of a classification derives from the higher level aggregations of the classification. The fact that the NOC and SOC 1991 had different structures, composed of different major groups and, therefore, a different order in which the minor groups and unit groups would appear in the structure, meant that inevitably the same minor and unit groups in the two structures would have different identification codes. Employment and Immigration Canada developed a 4-digit numbering system for the NOC that reflects the underlying skill level structure of the classification and allows the identification of the skill level of the groups of which the classification is composed. The NOC numbering system also indicates the collapsed unit groups previously described. Statistics Canada, in turn, developed a hierarchical numbering system, but for the convenience of users, the SOC 1991 carries a two-part numbering system for the minor and unit groups that the two classifications share. The first part of the two-part system derives from the structure of the SOC 1991 and the second part is the NOC 4-digit code. This two-part number will be used by Statistics Canada for disseminating occupational statistics. It will have the advantage of indicating to users, where a unit or minor group belongs in the NOC skill level

structure, and also allows users to group data up to whichever set of major groups they find useful.

Summary

In summary, several steps were taken to create a statistical classification. The first was to undertake a systematic study of the existing classification. These studies revealed, not only the extent of the problems, but suggested several classification changes and improvements. Typical classification changes resulted from identifying classes that could be split and portions of the "not elsewhere classified" classes that had the potential to become viable classes. For creating new unit groups, particular attention was paid to the service sector of the economy because of its growing significance and impact on the labour force. This continued the trend established in the previous revision that produced the 1980 SOC where a great majority of the new classes created were in the service sector. Typical classification improvements suggested by the studies included changes to make definitions more precise, the addition or subtraction of example titles, and collapsing of certain unit groups. In addition, it sometimes became apparent that when certain groups were being confused but should be kept, the impact of coding error could be reduced by the placement of the groups in the same minor group if they were not so placed in the existing classification. A detailed study of responses coded to the "not elsewhere classified" unit groups also revealed that they were being used as a mechanism for coding vague responses. The detailed analysis of vague response coding versus coding of responses as classified to the groups revealed the extent of the problem and the potential for concealment of information inherent in the structure of the existing classification.

Employment and Immigration Canada undertook surveys of actual employers, looking at the composition and content of jobs at various factories, offices, and other work sites. They created and proposed a set of unit groups that were deliberately designed to be very homogeneous by skill level and as such did not require extensive review on that criterion. They did however require an assessment as to their codeability and potential population. This was accomplished by actually coding the proposed classes using a large sample of captured responses that were assumed to be typical.

Groups that were clearly not codeable were rejected and groups that could be more easily coded, if adjusted, were modified. These adjustments were accomplished either by changing the content of the groups or by making the definitions and boundaries of the groups more clear and precise. This part of the work was done in two stages. First, with the help of a sample of responses from the 1986 Census of Population and again later after a pre-census test that emulated the conditions in which the Census of Population is actually conducted.

Alternative aggregations at the major group level have been designed to meet certain analytical needs of users and to have a population distribution that permitted maximum flexibility and publishability for this level in the structure.

Conclusions

The most obvious conclusion that we have reached is that it is possible to enhance the statistical implementability and usefulness of an occupational classification by the process that was followed in developing the Canadian classification. By formulating some basic objectives for the classification and undertaking the required analysis required to achieve the objectives, the 1991 SOC is a better statistical classification than its predecessor. Two important requirements for the analysis is the availability of scales indicative of skill attainment and a large sample of actual survey responses captured in machine readable form. Ideally all responses should be captured, as this would give a great amount of flexibility in classification development and implementation.

The development of the present integrated system that is practically the same at the unit and minor group levels and the same at the broad occupational category level only differing at the major group levels, optimizes the usefulness of the classification to both departments and caters to the two expressed needs of users. By adopting the two-part numbering system that makes quite clear the relationship between the two structures, any confusion between the two classifications has been minimized.

Appendix A. Standard Occupational Classification 1991 (SOC 1991)

The standard occupational classification is the standard classification used by Statistics Canada to classify data on occupations from the Census of Population. The standard occupational classification 1991 (SOC 1991) revises and updates the Standard Occupational Classification 1980 (SOC 1980). The 1991 Census of Population has been coded to both SOC 1980 and SOC 1991.

The SOC 1991 will replace the 1980 SOC as the standard for the Census of Population in 1996 and for the Labour Force Survey and other surveys at dates to be announced in the future.

The Relationship Between the Standard Occupational Classification 1991 and the National Occupational Classification

Statistics Canada and Employment and Immigration Canada have developed an integrated system of occupational classifications in the form of two classifications, the Standard Occupational Classification 1991 and the National Occupational Classification.

Structure

The two classifications share a common framework. They each have a hierarchical structure with *unit groups* at the most detailed level, which aggregate into *minor groups* and *major groups* and then into broad occupational categories.

They have 514 unit groups and 139 minor groups in common, and these are the unit and minor groups of the SOC 1991. The minor groups form 47 major groups in the SOC 1991 and 26 major groups in the NOC. At the very highest level the structures of the two classifications come together again into the same 10 broad occupational categories.

A coding system has been developed for the SOC 1991 that features a two-part numbering system for the unit groups and minor groups which includes the NOC code. This will indicate the place of the group in the NOC skill level/skill type structure and facilitate the grouping of data to the structure of either or both classifications.

Unit groups

There are 514 unit groups in the SOC and 522 in the NOC. They are identical with the exception of 16 NOC unit groups that could not be implemented by STC and were collapsed into 8 related pairs in the SOC. These collapsed unit groups can be identified easily as the unique final digit of the SOC code for these groups is 0. They are listed in table 1.

Table 1. SOC unit groups composed of collapsed pairs of NOC unit groups

SOC	NOC
A121.0210 Engineering, science and architecture managers	0211 Engineering managers 0212 Architecture and science managers
A141.0720 Facility operation and maintenance managers	0721 Facility operations managers 0722 Maintenance managers
C131.2230 Civil engineering technologists and technicians and construction estimators	2231 Civil engineering technologists and technicians 2234 Construction estimators
D223.3220 Dental technicians and laboratory bench workers	3223 Dental technicians 3412 Dental laboratory bench workers
E034.4160 Health and social policy researchers, researchers, consultants and program officers	4164 Social policy consultants and program officers 4165 Health policy researchers, consultants and program officers
G813.6470 Early childhood educators and assistants	4214 Early childhood educators 6473 Early childhood educator assistants
G731.6670 Attendants in amusement, recreation and sport	6443 Amusement attraction operators and other amusement occupations 6671 Attendants in recreation and sport

The 514 unit groups which the two classifications have in common, have the same labels and content. Very occasionally, the description of the unit groups may vary slightly but this is only a reflection of the fact that the SOC 1991 is primarily designed for statistical application. In the SOC 1991 and in the NOC, the description of each occupational group explains the characteristics of the group in terms of the principal tasks and duties of the jobs of which it is composed. In the NOC, certain other characteristics of the occupational group, such as entry level educational requirements, are also shown. In general, the example titles shown under the unit groups are the same, but some are unique to each classification. These differences arise because the intended uses of the classifications and thus the example titles needed, are somewhat different and the fact that the titles are

drawn from different sources. The titles shown as examples in the two classifications are listed alphabetically in the indexes which accompany the classifications. Despite these differences in example titles, there is no substantive difference in the content of the shared unit groups of the two classifications.

Military unit groups

The SOC and the NOC also differ in their classification of military personnel. All military personnel are classified solely on the basis of rank to either one of two SOC unit groups: A353.0643 Commissioned Officers, Armed Forces and G624.6464 Other Ranks, Armed Forces. On the other hand, the NOC unit groups for military occupations (0643 Commissioned Officers, Armed Forces and 6464 Occupations Unique to the Armed Forces) are defined to include only those military personnel whose occupations do not have a civilian counterpart (for example, infantry officers, artillery soldiers). Those military personnel whose occupations do have a civilian counterpart are classified in the unit group appropriate to the occupation (for example, dental officers are classified with dentists and military police officers are classified with police officers).

Minor Groups

The content of the 139 minor groups of the SOC 1991 and the NOC, become comparable once the 16 separate groups of the NOC have been collapsed into the 8 and assigned to the minor groups shown in table 1., with the exception of the different treatment of the military in the respective classifications.

Major groups and broad occupational categories

The two classifications share the same 10 broad occupational categories.

The 26 major groups of the NOC group the minor groups according to skill level under each broad occupational category. In this way the NOC major groups divide the 10 broad occupational categories by up to 4 skill levels that are defined in terms of education, training, experience or inherent talent. This allows for the creation of a skill type (broad occupational categories) by skill level (major groups) matrix to be found in the NOC.

In the SOC 1991 the minor groups are grouped into 47 major groups. This larger number of major groups occurs particularly in the two broad occupational categories Sales and Service Occupations and Trades, Transport and Equipment Operators and Related Occupations. These categories have large populations in the labour force and it was possible to exploit this to create a significant degree of occupational detail for their major groups. The criterion used to create the major groups of the SOC 1991 is kind of work performed. Some considerations that were kept in mind when designing the major groups of the SOC was to maximize the occupational detail available at the major group level and at the same time create groups with a population distribution that is as even as possible and have a population minimum sufficient to be used by the Census of Population for increased geographical detail and cross classifications; to be suitable as detailed classes for the Labour Force Survey, and to serve analytical needs not met by skill level major groups. Some of the major groups of the SOC 1991 are the same as those of the NOC, others are subdivisions of NOC major groups and yet others are quite different groupings of minor groups. The work performed focus and the population criteria used to create these groups resulted in skill type groups, 36 of which are also homogeneous by skill level.

The coding system

The coding system of the SOC 1991 has been designed to facilitate the use of the structure of either or both classifications. Census of Population data released on the basis of the SOC 1991 carries the two-part number, which gives users the opportunity to group the data to either the major groups of the SOC 1991 or to the major groups of the NOC or both.

The coding system of the occupational groups of the SOC 1991 are such that, within each broad occupational category, one or more major groups are identified; within each major group, one or more minor groups are identified and within each minor group one or more unit groups. The functional relationship is reinforced by means of the coding system. For example:

A	Management Occupations
A0	Senior Management Occupations
A01.001	Legislators and Senior Management
A011.0011	Legislators

It should be noted that in the SOC 1991 structure, the broad occupational category code is designated by a capital letter. The major group is designated by the same letter and one digit. For the minor and unit groups, a two part numbering system has been adopted. The first part of their codes, follows the structure of SOC 1991. The minor group carries the code of the SOC 1991 major group to which it belongs, with one additional digit. The unit group carries the code of the SOC 1991 major group to which it belongs, followed by two additional digits, the first being that of the minor group to which it belongs. After the dot is the actual NOC code.

In the NOC, the broad occupational categories carry the numbers 0 to 9. The coding system of the NOC follows the hierarchical structure of the classification in a manner similar to that of the SOC 1991. For example:

0	Management Occupations
00	Senior Management Occupations
001	Legislators and Senior Management
0011	Legislators

Tables 1 and 2 in the paper show the major groups of the SOC 1991 and the NOC with their codes in the two classifications.

In the example given above, the two classifications follow identical structures. However, in most instances the major groups of the two classifications differ. As this results in different structures and different codes for the minor and unit groups, a two part numbering system that incorporates the NOC codes, has been adopted for the SOC 1991.

For example, in the case of the unit group: G612.6262 Firefighters; G6 indicates the SOC 1991 major group, to which it belongs, Occupations in Protective Services and 62 indicates that it belongs to the major group, Skilled Sales and Service Occupations, in the NOC structure. As the coding system of the major groups of the NOC reflects their skill levels, with the exception of the management occupations, the second digit of the NOC code indicates to which of the four skill levels of the NOC the unit or minor group belongs.

NOC	SOC 1991
Sales and service occupations	Sales and service occupations
62 Skilled sales and service occupations	**G0** Sales and service supervisors
64 Intermediate sales and service occupations	**G1** Wholesale, technical, insurance, real estate sales specialists, and retail, wholesale and grain buyers
66 Elemental sales and service occupations	**G2** Retail salespersons and sales clerks
	G3 Cashiers
	G4 Chefs and cooks
	G5 Occupations in food and beverage service
	G6 Occupations in protective services
	G7 Occupations in travel and accommodation including attendants in recreation and sport
	G8 Childcare and home support workers
	G9 Sales and service occupations n.e.c.

The SOC 1991 and SOC 1980 are published by Statistics Canada

Standard Occupational Classification 1991 (to be released, July 1993)
Catalogue # 12–565E and 12–565F
Price: Canada: $80.00, United States: $96.00, Other Countries: $112.00

Standard Occupational Classification 1980
Catalogue # 12–565E and 12–565F
Price: Canada: $60.00, United States: $72.00, Other Countries: $84.00

Available From:
Marketing Division
Statistics Canada
Publications Sales
Tunney's Pasture, Ottawa,
Ontario K1A 0T6
Telephone (613) 951–7277
Toll free telephone 1–800–267–6677
Fax (613) 951–1584

Concordance Tables Between the SOC 1991 and Soc 1980

Concordances tables showing the classification relationships between the 1991 SOC and the 1980 SOC are included in the 1991 *SOC Manual.* The concordances are also available in machine readable form directly from the Standards Division of Statistics Canada. Telephone (613) 951–8576, FAX (613) 951–8576

The National Occupational Classification has been published by Employment and Immigration Canada
Catalogue # MP53–25/1–1993E
Price: Canada: $89.99 Outside Canada: $117.00

Available From:
Canada Communication Group Publishing
Ottawa, Canada K1A 0S9
Telephone, For Orders Only, (819) 956–4802
Fax: (819) 994–1498

Further Information

Further information about the SOC 1991 and the SOC 1980 and the availability of various classification components and related products in machine readable form can be obtained from:

Standards Division
Statistics Canada
Jean Talon Bldg., Section D–8
Tunney's Pasture, Ottawa, Ont.
Telephone (613) 951–8576
FAX. (613) 951–8576

Appendix B. 1991 SOC Classification Structure

A—Management Occupations

A0 Senior Management Occupations

A01.001 Legislators and Senior Management

A011.0011 Legislators
A012.0012 Senior government managers and officials
A013.0013 Senior managers—financial, communications carriers and other business services
A014.0014 Senior managers—health, education, social and community services and membership organizations
A015.0015 Senior managers—trade, broadcasting and other services, n.e.c.
A016.0016 Senior managers—goods production, utilities, transportation and construction

A1 Specialist Managers

A11.011 Administrative Services Managers

A111.0111 Financial managers
A112.0112 Human resources managers
A113.0113 Purchasing managers
A114.0114 Other administrative services managers

A12.021 Managers in Engineering, Architecture, Science and Information Systems

A121.0210 Engineering, science and architecture managers
A122.0213 Information systems and data processing managers

A13.061 Sales, Marketing and Advertising Managers

A131.0611 Sales, marketing and advertising managers

A14.072 Facility Operation and Maintenance Managers

A141.0720 Facility operation and maintenance managers

A2 Managers In Retail Trade, Food And Accommodation Services

A21.062 Managers in Retail Trade

A211.0621 Retail trade managers

A22.063 Managers in Food Service and Accommodation

A221.0631 Restaurant and food service managers
A222.0632 Accommodation service managers

A3 Other Managers N.E.C.

A30.012 Managers in financial and business services

A301.0121 Insurance, real estate and financial brokerage managers
A302.0122 Banking, credit and other investment managers
A303.0123 Other business services managers

A31.013 Managers in Communication (except Broadcasting)

A311.0131 Telecommunication carriers managers
A312.0132 Postal and courier services managers

A32.031 Managers in Health, Education, Social and Community Services

A321.0311 Managers in health care
A322.0312 Administrators in post-secondary education and vocational training
A323.0313 School principals and administrators of elementary and secondary education
A324.0314 Managers in social, community and correctional services

A33.041 Managers in Public Administration

A331.0411 Government managers in health and social policy development and program administration
A332.0412 Government managers in economic analysis, policy development and program administration
A333.0413 Government managers in education policy development and program administration

A334.0414 Other managers in public administration

A34.051 Managers in Art, Culture, Recreation and Sport

A341.0511 Library, archive, museum and art gallery managers
A342.0512 Managers in publishing, motion pictures, broadcasting and performing arts
A343.0513 Recreation and sport program and service directors

A35.064 Managers in Protective Service

A351.0641 Commissioned police officers
A352.0642 Fire chiefs and senior fire-fighting officers
A353.0643 Commissioned officers, armed forces

A36.065 Managers in Other Services

A361.0651 Other services managers

A37.071 Managers in Construction and Transportation

A371.0711 Construction managers
A372.0712 Residential home builders and renovators
A373.0713 Transportation managers

A38.081 Managers in Primary Production (except Agriculture)

A381.0811 Primary production managers (except agriculture)

A39.091 Managers in Manufacturing and Utilities

A391.0911 Manufacturing managers
A392.0912 Utilities managers

B—Business, Finance And Administration Occupations

B0 Professional Occupations In Business And Finance

B01.111 Auditors, Accountants and Investment Professionals

B011.1111 Financial auditors and accountants
B012.1112 Financial and investment analysts
B013.1113 Securities agents, investment dealers and traders
B014.1114 Other financial officers

B02.112 Human Resources and Business Service Professionals

B021.1121 Specialists in human resources
B022.1122 Professional occupations in business services to management

B1 Finance And Insurance Administrative Occupations

B11.123 Finance and Insurance Administrative Occupations

B111.1231 Bookkeepers
B112.1232 Loan officers
B113.1233 Insurance adjusters and claims examiners
B114.1234 Insurance underwriters
B115.1235 Assessors, valuators and appraisers
B116.1236 Customs, ship and other brokers

B2 Secretaries

B21.124 Secretaries, Recorders and Transcriptionists

B211.1241 Secretaries (except legal and medical)
B212.1242 Legal secretaries
B213.1243 Medical secretaries
B214.1244 Court recorders and medical transcriptionists

B3 Administrative And Regulatory Occupations

B31.122 Administrative and Regulatory Occupations

B311.1221 Administrative officers
B312.1222 Executive assistants
B313.1223 Personnel and recruitment officers
B314.1224 Property administrators
B315.1225 Purchasing agents and officers
B316.1226 Conference and event planners
B317.1227 Court officers and justices of the peace
B318.1228 Immigration, unemployment insurance and revenue officers

B4 Clerical Supervisors

B41.121 Clerical Supervisors

B411.1211 Supervisors, general office and administrative support clerks
B412.1212 Supervisors, finance and insurance clerks
B413.1213 Supervisors, library, correspondence and related information clerks
B414.1214 Supervisors, mail and message distribution occupations
B415.1215 Supervisors, recording, distributing and scheduling occupations

B5 Clerical Occupations

B51.141 Clerical Occupations, General Office Skills

B511.1411 General office clerks
B512.1412 Typists and word processing operators

B513.1413 Records and file clerks
B514.1414 Receptionists and switchboard operators

B52.142 Office Equipment Operators

B521.1421 Computer operators
B522.1422 Data entry clerks
B523.1423 Typesetters and related occupations
B524.1424 Telephone operators

B53.143 Finance and Insurance Clerks

B531.1431 Accounting and related clerks
B532.1432 Payroll clerks
B533.1433 Tellers, financial services
B534.1434 Banking, insurance and other financial clerks
B535.1435 Collectors

B54.144 Administrative Support Clerks

B541.1441 Administrative clerks
B542.1442 Personnel clerks
B543.1443 Court clerks

B55.145 Library, Correspondence and Related Information Clerks

B551.1451 Library Clerks
B552.1452 Correspondence, publication and related clerks
B553.1453 Customer service, information and related clerks
B554.1454 Survey interviewers and statistical clerks

B56.146 Mail and Message Distribution Occupations

B561.1461 Mail, postal and related clerks
B562.1462 Letter carriers
B563.1463 Couriers and messengers

B57.147 Recording, Scheduling and Distributing Occupations

B571.1471 Shippers and receivers
B572.1472 Storekeepers and parts clerks
B573.1473 Production clerks
B574.1474 Purchasing and inventory clerks
B575.1475 Dispatchers and radio operators
B576.1476 Transportation route and crew schedulers

C—Natural And Applied Sciences And Related Occupations

C0 Professional Occupations In Natural And Applied Sciences

C01.211 Physical Science Professionals

C011.2111 Physicists and astronomers
C012.2112 Chemists
C013.2113 Geologists, geochemists and geophysicists
C014.2114 Meteorologists
C015.2115 Other professional occupations in physical sciences

C02.212 Life Science Professionals

C021.2121 Biologists and related scientists
C022.2122 Forestry professionals
C023.2123 Agricultural representatives, consultants and specialists

C03.213 Civil, Mechanical, Electrical and Chemical Engineers

C031.2131 Civil engineers
C032.2132 Mechanical engineers
C033.2133 Electrical and electronics engineers
C034.2134 Chemical engineers

C04.214 Other Engineers

C041.2141 Industrial and manufacturing engineers
C042.2142 Metallurgical and materials engineers
C043.2143 Mining engineers
C044.2144 Geological engineers
C045.2145 Petroleum engineers
C046.2146 Aerospace engineers
C047.2147 Computer engineers
C048.2148 Other professional engineers, n.e.c.

C05.215 Architects, Urban Planners and Land Surveyors

C051.2151 Architects
C052.2152 Landscape architects
C053.2153 Urban and land use planners
C054.2154 Land surveyors

C06.216 Mathematicians, Systems Analysts and Computer Programmers

C061.2161 Mathematicians, statisticians and actuaries
C062.2162 Computer systems analysts
C063.2163 Computer programmers

C1 Technical Occupations In Natural And Applied Sciences

C11.221 Technical Occupations in Physical Sciences

C111.2211 Applied chemical technologists and technicians
C112.2212 Geological and mineral technologists and technicians
C113.2213 Meteorological technicians

C12.222 Technical Occupations in Life Sciences

C121.2221 Biological technologists and technicians
C122.2222 Agricultural and fish products inspectors
C123.2223 Forestry technologists and technicians
C124.2224 Conservation and fishery officers
C125.2225 Landscape and horticultural technicians and specialists

C13.223 Technical Occupations in Civil, Mechanical and Industrial Engineering

C131.2230 Civil engineering technologists and technicians and construction estimators
C132.2232 Mechanical engineering technologists and technicians
C133.2233 Industrial engineering and manufacturing technologists and technicians

C14.224 Technical Occupations in Electronics and Electrical Engineering

C141.2241 Electrical and electronics engineering technologists and technicians
C142.2242 Electronic service technicians (household and business equipment)
C143.2243 Industrial instrument technicians and mechanics
C144.2244 Aircraft instrument, electrical and avionics mechanics, technicians and inspectors

C15.225 Technical Occupations in Architecture, Drafting, Surveying and Mapping

C151.2251 Architectural technologists and technicians
C152.2252 Industrial designers
C153.2253 Drafting technologists and technicians
C154.2254 Survey technologists and technicians
C155.2255 Mapping and related technologists and technicians

C16.226 Other Technical Inspectors and Regulatory Officers

C161.2261 Nondestructive testers and inspectors
C162.2262 Engineering inspectors and regulatory officers
C163.2263 Inspectors in public and environmental health and occupational health and safety
C164.2264 Construction inspectors

C17.227 Transportation Officers and Controllers

C171.2271 Air pilots, flight engineers and flying instructors
C172.2272 Air traffic control occupations
C173.2273 Deck officers, water transport
C174.2274 Engineer officers, water transport
C175.2275 Railway and marine traffic controllers

D—Health Occupations

D0 Professional Occupations In Health

D01.311 Physicians, Dentists and Veterinarians

D011.3111 Specialist physicians
D012.3112 General practitioners and family physicians
D013.3113 Dentists
D014.3114 Veterinarians

D02.312 Optometrists, Chiropractors and Other Health Diagnosing and Treating Professionals

D021.3121 Optometrists
D022.3122 Chiropractors
D023.3123 Other professional occupations in health diagnosing and treating

D03.313 Pharmacists, Dietitians and Nutritionists

D031.3131 Pharmacists
D032.3132 Dietitians and nutritionists

D04.314 Therapy and Assessment Professionals

D041.3141 Audiologists and speech-language pathologists
D042.3142 Physiotherapists
D043.3143 Occupational therapists
D044.3144 Other professional occupations in therapy and assessment

D1 Nurse Supervisors And Registered Nurses

D11.315 Nurse Supervisors and Registered Nurses

D111.3151 Head nurses and supervisors
D112.3152 Registered nurses

D2 Technical And Related Occupations In Health

D21.321 Medical Technologists and Technicians (except Dental Health)

D211.3211 Medical laboratory technologists and pathologists' assistants
D212.3212 Medical laboratory technicians
D213.3213 Animal health technologists
D214.3214 Respiratory therapists and clinical perfusionists
D215.3215 Medical radiation technologists
D216.3216 Medical sonographers
D217.3217 Cardiology technologists
D218.3218 Electroencephalographic and other diagnostic technologists, n.e.c.
D219.3219 Other medical technologists and technicians (except dental health)

D22.322 Technical Occupations in Dental Health Care

D221.3221 Denturists
D222.3222 Dental hygienists and dental therapists
D223.3220 Dental technicians and laboratory bench workers

D23.323 Other Technical Occupations in Health Care (except Dental)

D231.3231 Opticians
D232.3232 Midwives and practitioners of natural healing
D233.3233 Registered nursing assistants
D234.3234 Ambulance attendants and other paramedical occupations
D235.3235 Other technical occupations in therapy and assessment

D3 Assisting Occupations In Support Of Health Services

D31.341 Assisting Occupations in Support of Health Services

D311.3411 Dental assistants
D312.3413 Nurse aides and orderlies
D313.3414 Other aides and assistants in support of health services

E—Occupations In Social Science, Education, Government Service And Religion

E0 Judges, Lawyers, Psychologists, Social Workers, Ministers Of Religion And Policy And Program Officers

E01.411 Judges, Lawyers and Quebec Notaries

E011.4111 Judges
E012.4112 Lawyers and Quebec notaries

E02.415 Psychologists, Social Workers, Counsellors, Clergy and Probation Officers

E021.4151 Psychologists
E022.4152 Social workers
E023.4153 Family, marriage and other related counsellors
E024.4154 Ministers of religion
E025.4155 Probation and parole officers and related occupations

E03.416 Policy and Program Officers, Researchers and Consultants

E031.4161 Natural and applied science policy researchers, consultants and program officers
E032.4162 Economists and economic policy researchers and analysts
E033.4163 Economic development officers and marketing researchers and consultants
E034.4160 Health and social policy researchers, consultants and program officers
E035.4166 Education policy researchers, consultants and program officers
E036.4167 Recreation and sports program supervisors and consultants
E037.4168 Program officers unique to government
E038.4169 Other professional occupations in social science

E1 Teachers And Professors

E11.412 University Professors and Assistants

E111.4121 University professors
E112.4122 Post-secondary teaching and research assistants

E12.413 College and Other Vocational Instructors

E121.4131 College and other vocational instructors

E13.414 Secondary and Elementary School Teachers and Counsellors

E131.4141 Secondary school teachers
E132.4142 Elementary school and kindergarten teachers
E133.4143 School and guidance counsellors

E2 Paralegals, Social Services Workers And Occupations In Education And Religion, N.E.C.

E21.421 Paralegals, Social Services Workers and Occupations in Education and Religion, n.e.c.

E211.4211 Paralegal and related occupations
E212.4212 Community and social service workers
E213.4213 Employment counsellors
E214.4215 Instructors and teachers of disabled persons
E215.4216 Other instructors
E216.4217 Other religious occupations

F—Occupations In Art, Culture, Recreation And Sport

F0 Professional Occupations In Art And Culture

F01.511 Librarians, Archivists, Conservators and Curators

F011.5111 Librarians
F012.5112 Conservators and curators
F013.5113 Archivists

F02.512 Writing, Translating and Public Relations Professionals

F021.5121 Writers
F022.5122 Editors
F023.5123 Journalists
F024.5124 Professional occupations in public relations and communications
F025.5125 Translators, terminologists and interpreters

F03.513 Creative and Performing Artists

F031.5131 Producers, directors, choreographers and related occupations
F032.5132 Conductors, composers and arrangers
F033.5133 Musicians and singers
F034.5134 Dancers
F035.5135 Actors
F036.5136 Painters, sculptors and other visual artists

F1 Technical Occupations In Art, Culture, Recreation And Sport

F11.521 Technical Occupations in Libraries, Archives, Museums and Galleries

F111.5211 Library and archive technicians and assistants
F112.5212 Technical occupations related to museums and galleries

F12.522 Photographers, Graphic Arts Technicians and Technical Occupations in Motion Pictures, Broadcasting and the Performing Arts

F121.5221 Photographers
F122.5222 Film and video camera operators
F123.5223 Graphic arts technicians
F124.5224 Broadcast technicians
F125.5225 Audio and video recording technicians
F126.5226 Other technical occupations in motion pictures, broadcasting and the performing arts
F127.5227 Support and assisting occupations in motion pictures, broadcasting and the performing arts

F13.523 Announcers and Other Performers

F131.5231 Announcers and other broadcasters
F132.5232 Other performers

F14.524 Creative Designers and Craftspersons

F141.5241 Graphic designers and illustrating artists
F142.5242 Interior designers
F143.5243 Theatre, fashion, exhibit and other creative designers
F144.5244 Artisans and craftspersons
F145.5245 Patternmakers—textile, leather and fur products

F15.525 Athletes, Coaches, Referees and Related Occupations

F151.5251 Athletes
F152.5252 Coaches
F153.5253 Sports officials and referees
F154.5254 Program leaders and instructors in recreation and sport

G—Sales And Service Occupations

G0 Sales And Service Supervisors

G01.621 Sales and Service Supervisors

G011.6211 Retail trade supervisors

G012.6212 Food service supervisors
G013.6213 Executive housekeepers
G014.6214 Dry cleaning and laundry supervisors
G015.6215 Cleaning supervisors
G016.6216 Other service supervisors

G1 Wholesale, Technical, Insurance, Real Estate Sales Specialists, And Retail, Wholesale, And Grain Buyers

G11.641 Sales Representatives, Wholesale Trade

G111.6411 Sales representatives, wholesale trade (nontechnical)

G12.622 Technical Sales Specialists, Wholesale Trade

G121.6221 Technical sales specialists, wholesale trade

G13.623 Insurance and Real Estate Sales Occupations and Buyers

G131.6231 Insurance agents and brokers
G132.6232 Real estate agents and salespersons
G133.6233 Retail and wholesale buyers
G134.6234 Grain elevator operators

G2 Retail Salespersons And Sales Clerks

G21.642 Retail Salespersons and Sales Clerks

G211.6412 Retail salespersons and sales clerks

G3 Cashiers

G31.661 Cashiers

G311.6611 Cashiers

G4 Chefs And Cooks

G41.624 Chefs and Cooks

G411.6241 Chefs
G412.6242 Cooks

G5 Occupations In Food And Beverage Service

G51.645 Occupations in Food and Beverage Service

G511.6451 Maîtres d'hôtel and hosts/hostesses
G512.6452 Bartenders
G513.6453 Food and beverage servers

G6 Occupations In Protective Services

G61.626 Police Officers and Fire-fighters

G611.6261 Police officers (except commissioned)
G612.6262 Fire-fighters

G62.646 Other Occupations in Protective Service

G621.6461 Sheriffs and bailiffs
G622.6462 Correctional service officers
G623.6463 By-law enforcement and other regulatory officers, n.e.c.
G624.6464 Other ranks, armed forces
G625.6465 Other protective service occupations

G63.665 Security Guards and Related Occupations

G631.6651 Security guards and related occupations

G7 Occupations In Travel And Accommodation Including Attendants In Recreation And Sport

G71.643 Occupations in Travel and Accommodation

G711.6431 Travel counsellors
G712.6432 Pursers and flight attendants
G713.6433 Airline sales and service agents
G714.6434 Ticket and cargo agents and related clerks (except airline)
G715.6435 Hotel front desk clerks

G72.644 Tour and Recreational Guides and Amusement Occupations

G721.6441 Tour and travel guides
G722.6442 Outdoor sport and recreational guides

G73.667 Other Attendants in Travel, Accommodation and Recreation

G731.6670 Attendants in amusement, recreation and sport
G732.6672 Other attendants in accommodation and travel (except airline travel)

G8 Childcare And Home Support Workers

G81.647 Childcare and Home Support Workers

G811.6471 Visiting homemakers, housekeepers and related occupations
G812.6472 Elementary and secondary school teacher assistants
G813.6470 Early childhood educators and assistants
G814.6474 Babysitters, nannies and parents' helpers

G9 Sales And Service Occupations N.E.C.

G91.627 Technical Occupations in Personal Service

G911.6271 Hairstylists and barbers
G912.6272 Funeral directors and embalmers

G92.648 Other Occupations in Personal Service

G921.6481 Image, social and other personal consultants
G922.6482 Estheticians, electrologists and related occupations
G923.6483 Pet groomers and animal care workers
G924.6484 Other personal service occupations

G93.666 Cleaners

G931.6661 Light duty cleaners
G932.6662 Specialized cleaners
G933.6663 Janitors, caretakers and building superintendents

G94.625 Butchers and Bakers

G941.6251 Butchers and meat cutters, retail and wholesale
G942.6252 Bakers

G95.663 Elemental Medical and Hospital Assistants

G951.6631 Elemental medical and hospital assistants

G96.664 Food Counter Attendants and Kitchen Helpers

G961.6641 Food service counter attendants and food preparers
G962.6642 Kitchen and food service helpers

G97.662 Other Sales And Related Occupations

G971.6621 Service station attendants
G972.6622 Grocery clerks and shelf stockers
G973.6623 Other elemental sales occupations

G98.668 Other Elemental Service Occupations

G981.6681 Dry cleaning and laundry occupations
G982.6682 Ironing, pressing and finishing occupations
G983.6683 Other elemental service occupations

H—Trades, Transport And Equipment Operators And Related Occupations

H0 Supervisors And Contractors In Trades And Transportation

H01.721 Contractors and Supervisors, Trades and Related Workers

H011.7211 Supervisors, machinists and related occupations
H012.7212 Contractors and supervisors, electrical trades and telecommunications occupations
H013.7213 Contractors and supervisors, pipefitting trades
H014.7214 Contractors and supervisors, metal forming, shaping and erecting trades
H015.7215 Contractors and supervisors, carpentry trades
H016.7216 Contractors and supervisors, mechanic trades
H017.7217 Contractors and supervisors, heavy construction equipment crews
H018.7218 Supervisors, printing and related occupations
H019.7219 Contractors and supervisors, other construction trades, installers, repairers and servicers

H02.722 Supervisors, Railway and Motor Transportation Occupations

H021.7221 Supervisors, railway transport operations
H022.7222 Supervisors, motor transport and other ground transit operators

H1 Construction Trades

H11.725 Plumbers, Pipefitters and Gas Fitters

H111.7251 Plumbers
H112.7252 Steamfitters, pipefitters and sprinkler system installers
H113.7253 Gas fitters

H12.727 Carpenters and Cabinetmakers

H121.7271 Carpenters
H122.7272 Cabinetmakers

H13.728 Masonry and Plastering Trades

H131.7281 Bricklayers
H132.7282 Cement finishers
H133.7283 Tilesetters
H134.7284 Plasterers, drywall installers and finishers and lathers

H14.729 Other Construction Trades

H141.7291 Roofers and shinglers
H142.7292 Glaziers
H143.7293 Insulators
H144.7294 Painters and decorators
H145.7295 Floor covering installers

H2 Stationary Engineers, Power Station Operators And Electrical Trades And Telecommunication Occupations

H21.724 Electrical Trades and Telecommunication Occupations

H211.7241 Electricians (except industrial and power system)
H212.7242 Industrial electricians

H213.7243 Power system electricians
H214.7244 Electrical power line and cable workers
H215.7245 Telecommunications line and cable workers
H216.7246 Telecommunications installation and repair workers
H217.7247 Cable television service and maintenance technicians

H22.735 Stationary Engineers and Power Station and System Operators

H221.7351 Stationary engineers and auxiliary equipment operators
H222.7352 Power systems and power station operators

H3 Machinists, Metal Forming, Shaping And Erecting Occupations

H31.723 Machinists and Related Occupations

H311.7231 Machinists and machining and tooling inspectors
H312.7232 Tool and die makers

H32.726 Metal Forming, Shaping and Erecting Occupations

H321.7261 Sheet metal workers
H322.7262 Boilermakers
H323.7263 Structural metal and platework fabricators and fitters
H324.7264 Ironworkers
H325.7266 Blacksmiths and die setters

H4 Mechanics

H41.731 Machinery and Transportation Equipment Mechanics (except Motor Vehicle)

H411.7311 Construction millwrights and industrial mechanics (except textile)
H412.7312 Heavy-duty equipment mechanics
H413.7313 Refrigeration and air-conditioning mechanics
H414.7314 Railway carmen/women
H415.7315 Aircraft mechanics and aircraft inspectors
H416.7316 Machine fitters
H417.7317 Textile machinery mechanics and repairers
H418.7318 Elevator constructors and mechanics

H42.732 Motor Vehicle Mechanics

H421.7321 Motor vehicle mechanics, technicians and mechanical repairers
H422.7322 Motor vehicle body repairers

H43.733 Other Mechanics

H431.7331 Oil and solid fuel heating mechanics
H432.7332 Electric appliance servicers and repairers
H433.7333 Electrical mechanics
H434.7334 Motorcycle and other related mechanics
H435.7335 Other small engine and equipment mechanics

H5 Other Trades N.E.C.

H51.734 Upholsterers, Tailors, Shoe Repairers, Jewellers and Related Occupations

H511.7341 Upholsterers
H512.7342 Tailors, dressmakers, furriers and milliners
H513.7343 Shoe repairers and shoemakers
H514.7344 Jewellers, watch repairers and related occupations

H52.738 Printing Press Operators, Commercial Divers and Other Trades and Related Occupations, n.e.c.

H521.7381 Printing press operators
H522.7382 Commercial divers
H523.7383 Other trades and related occupations

H53.744 Other Installers, Repairers and Servicers

H531.7441 Residential and commercial installers and servicers
H532.7442 Waterworks and gas maintenance workers
H533.7443 Automotive mechanical installers and servicers
H534.7444 Pest controllers and fumigators
H535.7445 Other repairers and servicers

H6 Heavy Equipment And Crane Operators Including Drillers

H61.742 Heavy Equipment Operators

H611.7421 Heavy equipment operators (except crane)
H612.7422 Public works maintenance equipment operators

H62.737 Crane Operators, Drillers and Blasters

H621.7371 Crane operators
H622.7372 Drillers and blasters—surface mining, quarrying and construction
H623.7373 Water well drillers

H7 Transportation Equipment Operators And Related Workers, Excluding Labourers

H71.741 Motor Vehicle and Transit Drivers

H711.7411 Truck drivers
H712.7412 Bus drivers and subway and other transit operators

H713.7413 Taxi and limousine drivers and chauffeurs
H714.7414 Delivery drivers

H72.736 Train Crew Operating Occupations

H721.7361 Railway and yard locomotive engineers
H722.7362 Railway conductors and brakemen/women

H73.743 Other Transport Equipment Operators and Related Workers

H731.7431 Railway yard workers
H732.7432 Railway track maintenance workers
H733.7433 Deck crew, water transport
H734.7434 Engine room crew, water transport
H735.7435 Lock and cable ferry operators and related occupations
H736.7436 Boat operators
H737.7437 Air transport ramp attendants

H8 Trades Helpers, Construction And Transportation Labourers And Related Occupations

H81.745 Longshore Workers and Material Handlers

H811.7451 Longshore workers
H812.7452 Material handlers

H82.761 Trades Helpers and Labourers

H821.7611 Construction trades helpers and labourers
H822.7612 Other trades helpers and labourers

H83.762 Public Works and Other Labourers, n.e.c.

H831.7621 Public works and maintenance labourers
H832.7622 Railway and motor transport labourers

I—Occupations Unique To Primary Industry

I0 Occupations Unique To Agriculture Excluding Labourers

I01.825 Contractors, Operators and Supervisors in Agriculture, Horticulture and Aquaculture

I011.8251 Farmers and farm managers
I012.8252 Agricultural and related service contractors and managers
I013.8253 Farm supervisors and specialized livestock workers
I014.8254 Nursery and greenhouse operators and managers
I015.8255 Landscaping and grounds maintenance contractors and managers
I016.8256 Supervisors, landscape and horticulture
I017.8257 Aquaculture operators and managers

I02.843 Agriculture and Horticulture Workers

I021.8431 General farm workers
I022.8432 Nursery and greenhouse workers

I1 Occupations Unique To Forestry Operations, Mining, Oil And Gas Extraction, And Fishing, Excluding Labourers

I11.821 Supervisors, Logging and Forestry

I111.8211 Supervisors, logging and forestry

I12.822 Supervisors, Mining, Oil and Gas

I121.8221 Supervisors, mining and quarrying
I122.8222 Supervisors, oil and gas drilling and service

I13.823 Underground Miners, Oil and Gas Drillers and Related Workers

I131.8231 Underground production and development miners
I132.8232 Oil and gas well drillers, servicers, testers and related workers

I14.841 Mine Service Workers and Operators in Oil and Gas Drilling

I141.8411 Underground mine service and support workers
I142.8412 Oil and gas well drilling workers and services operators

I15.824 Logging Machinery Operators

I151.8241 Logging machinery operators

I16.842 Logging and Forestry Workers

I161.8421 Chain-saw and skidder operators
I162.8422 Silviculture and forestry workers

I17.826 Fishing Vessel Masters and Skippers and Fishermen/women

I171.8261 Fishing masters and officers
I172.8262 Fishing vessel skippers and fishermen/women

I18.844 Other Fishing and Trapping Occupations

I181.8441 Fishing vessel deckhands
I182.8442 Trappers and hunters

I2 Primary Production Labourers

I21.861 Primary Production Labourers

I211.8611 Harvesting labourers
I212.8612 Landscaping and grounds maintenance labourers
I213.8613 Aquaculture and marine harvest labourers
I214.8614 Mine labourers
I215.8615 Oil and gas drilling, servicing and related labourers
I216.8616 Logging and forestry labourers

J—Occupations Unique To Processing, Manufacturing And Utilities

J0 Supervisors In Manufacturing

J01.921 Supervisors, Processing Occupations

J011.9211 Supervisors, mineral and metal processing
J012.9212 Supervisors, petroleum, gas and chemical processing and utilities
J013.9213 Supervisors, food, beverage and tobacco processing
J014.9214 Supervisors, plastic and rubber products manufacturing
J015.9215 Supervisors, forest products processing
J016.9216 Supervisors, textile processing

J02.922 Supervisors, Assembly and Fabrication

J021.9221 Supervisors, motor vehicle assembling
J022.9222 Supervisors, electronics manufacturing
J023.9223 Supervisors, electrical products manufacturing
J024.9224 Supervisors, furniture and fixtures manufacturing
J025.9225 Supervisors, fabric, fur and leather products manufacturing
J026.9226 Supervisors, other mechanical and metal products manufacturing
J027.9227 Supervisors, other products manufacturing and assembly

J1 Machine Operators In Manufacturing

J11.923 Central Control and Process Operators in Manufacturing and Processing

J111.9231 Central control and process operators, mineral and metal processing
J112.9232 Petroleum, gas and chemical process operators
J113.9233 Pulping control operators
J114.9234 Papermaking and coating control operators

J12.941 Machine Operators and Related Workers in Metal and Mineral Products Processing

J121.9411 Machine operators, mineral and metal processing
J122.9412 Foundry workers
J123.9413 Glass forming and finishing machine operators and glass cutters
J124.9414 Concrete, clay and stone forming operators
J125.9415 Inspectors and testers, mineral and metal processing

J13.942 Machine Operators and Related Workers in Chemical, Plastic and Rubber Processing

J131.9421 Chemical plant machine operators
J132.9422 Plastics processing machine operators
J133.9423 Rubber processing machine operators and related workers
J134.9424 Water and waste plant operators

J14.943 Machine Operators and Related Workers in Pulp and Paper Production and Wood Processing

J141.9431 Sawmill machine operators
J142.9432 Pulp mill machine operators
J143.9433 Papermaking and finishing machine operators
J144.9434 Other wood processing machine operators
J145.9435 Paper converting machine operators
J146.9436 Lumber graders and other wood processing inspectors and graders

J15.944 Machine Operators and Related Workers in Textile Processing

J151.9441 Textile fibre and yarn preparation machine operators
J152.9442 Weavers, knitters and other fabric-making occupations
J153.9443 Textile dyeing and finishing machine operators
J154.9444 Textile inspectors, graders and samplers

J16.945 Machine Operators and Related Workers in Fabric, Fur and Leather Products Manufacturing

J161.9451 Sewing machine operators
J162.9452 Fabric, fur and leather cutters
J163.9453 Hide and pelt processing workers
J164.9454 Inspectors and testers, fabric, fur and leather products manufacturing

J17.946 Machine Operators and Related Workers in Food, Beverage and Tobacco Processing

J171.9461 Process control and machine operators, food and beverage processing
J172.9462 Industrial butchers and meat cutters, poultry preparers and related workers
J173.9463 Fish plant workers
J174.9464 Tobacco processing machine operators
J175.9465 Testers and graders, food and beverage processing

J18.947 Printing Machine Operators and Related Occupations

J181.9471 Printing machine operators
J182.9472 Camera, platemaking and other pre-press occupations
J183.9473 Binding and finishing machine operators
J184.9474 Photographic and film processors

J19.951 Machining, Metalworking, Woodworking and Related Machine Operators

J191.9511 Machining tool operators
J192.9512 Forging machine operators
J193.9513 Woodworking machine operators
J194.9514 Metalworking machine operators
J195.9510 Welders and Soldering machine operators
J196.9516 Other metal products machine operators
J197.9517 Other products machine operators

J2 Assemblers In Manufacturing

J21.948 Mechanical, Electrical and Electronics Assemblers

J211.9481 Aircraft assemblers and aircraft assembly inspectors
J212.9482 Motor vehicle assemblers, inspectors and testers
J213.9483 Electronics assemblers, fabricators, inspectors and testers
J214.9484 Assemblers and inspectors, electrical appliance, apparatus and equipment manufacturing
J215.9485 Assemblers, fabricators and inspectors, industrial electrical motors and transformers
J216.9486 Mechanical assemblers and inspectors
J217.9487 Machine operators and inspectors, electrical apparatus manufacturing

J22.949 Other Assembly and Related Occupations

J221.9491 Boat assemblers and inspectors
J222.9492 Furniture and fixture assemblers and inspectors
J223.9493 Other wood products assemblers and inspectors
J224.9494 Furniture finishers and refinishers
J225.9495 Plastic products assemblers, finishers and inspectors
J226.9496 Painters and coaters, manufacturing
J227.9497 Plating, metal spraying and related operators
J228.9498 Other assemblers and inspectors

J3 Labourers In Processing, Manufacturing And Utilities

J31.961 Labourers in Processing, Manufacturing and Utilities

J311.9611 Labourers in mineral and metal processing
J312.9612 Labourers in metal fabrication
J313.9613 Labourers in chemical products processing and utilities
J314.9614 Labourers in wood, pulp and paper processing
J315.9615 Labourers in rubber and plastic products manufacturing
J316.9616 Labourers in textile processing
J317.9617 Labourers in food, beverage and tobacco processing
J318.9618 Labourers in fish processing
J319.9619 Other labourers in processing, manufacturing and utilities

The National Occupational Classification of Canada

Margaret Roberts
Employment and Immigration Canada

The *National Occupational Classification* (NOC) is a system that classifies and describes occupations in the Canadian labour market. It is based on several years of extensive occupational research and analysis and replaced the *Canadian Classification and Dictionary of Occupations* (CCDO) in the spring of 1993. The NOC presents a new structural context for the Canadian labour market, reflecting occupational changes that have taken place over the past two decades. Unlike the CCDO, the NOC does not include dictionary-style definitions of occupations, nor does it code and differentiate thousands of specific jobs. Rather, occupations are classified into 522 groups, to which over 25,000 job titles are assigned. The NOC serves as a framework whose main function is to provide structure and meaning to the labour market as a whole.

Levels of aggregation

The NOC structure is a three-tiered hierarchical arrangement of occupational groupings. It is comprised of 26 major groups (the broadest level), 139 minor groups (the intermediate level), and 522 unit groups (the detailed level). The NOC also includes over 25,000 occupational titles that have been assigned to unit groups.

Each major group, minor group and unit group has its own unique code. A 2-digit code is assigned at the major group level. A third digit is added at the minor group level and a fourth digit is added at the unit group level. For example:

Major Group 31: Professional occupations in health

Minor Group 314: Professional occupations in therapy and assessment

Unit Group 3142: Physiotherapists

Classification criteria

Classification systems, including the CCDO, have historically used the criterion of "type of work performed" as the basis for grouping occupations. The NOC retains this criterion (labelled the skill type criterion), but has complemented it with a second criterion: the type and length of education and training that are required to perform the occupation (the skill level criterion). Occupational groupings in the NOC, at all levels, reflect these two main classification criteria to as great an extent as possible.

The use of two criteria in the NOC means that the classification can be organized or viewed either from a skill level perspective, a skill type perspective or a combination of the two. This flexibility will allow users to approach the 26 major groups from the perspective that is best suited to their needs.

Two other factors were also considered in the development of NOC groups. First, industry was considered where a specific industry was the sole supplier for a particular occupation (for example, unit group 9482, *Motor vehicle assemblers, inspectors, and testers*). Second, a sub-function of the skill type and skill level criteria is worker mobility. A deliberate attempt was made to group occupations by degree of mobility, that is, workers generally are more likely to be able to move to other occupations in their own unit group than to occupations in other unit groups.

The NOC is organized first by broad skill type and then by skill level within each skill type category. The skill type and skill level of each major, minor and unit group are indicated by the first two digits of the code.

Skill level. The concept of skill level in the NOC is defined as the type and length of education, training or experience that is required for employment in an occupation. In classifying occupations at the unit group level, an attempt was made to include occupations that share similar employment requirements. Upon doing so, four broad skill level categories emerged, which can be described as follows:

Skill level A: Occupations that generally require completion of a university program at the Bachelor's, Master's, or Doctorate level;

Skill level B: Occupations that require 1–3 years of post-secondary education (college or university): occupations that require completion of a 2- to 5-year apprenticeship program; occupations that require a combination of specialized training and several years of experience in another occupation;

Skill level C: Occupations that require high school education combined with up to 1 year of post-secondary education or on-the-job training;

Skill level D: Occupations that require some high school education combined with a short period of on-the-job training.

Each major, minor, and unit group in the NOC falls within one of these skill level categories. The four skill level categories are broad aggregates, but nevertheless reflect the main types of employment requirements that characterize the labour market.

Skill type. The concept of skill type in the NOC is defined as the type of work performed: To as great an extent as possible, occupations that are similar in this respect are classified together. As NOC unit groups were developed, nine broad skill type categories emerged. These nine categories do not represent a formal aggregation level and should not be confused with the major group level of the classification. Rather, the categories offer an organizational principle for approaching the NOC from a skill type perspective. Each unit group, minor group and non-management major group belongs to one of the nine skill type categories. The skill type categories are comprised of:

Legislators and senior management:
This skill type category contains legislators and senior management occupations. Middle and other management occupations are assigned to the appropriate skill type category.

Business, finance, and administration:
This category contains occupations that are concerned with providing financial and business services, administrative and regulatory services, and clerical support services.

Natural and applied science:
This category contains management, professional and technical occupations in the sciences, including physical and life sciences, engineering and architecture.

Health:
This category includes occupations concerned with managing health care and providing health care services directly to patients or in support of professional and technical staff.

Social science, education, government service, and religion:
This skill type category includes a range of occupations that are concerned with law, teaching, counselling, conducting social science research, and administering government and other programs. It also includes related management occupations.

Art, culture, recreation, and sport:
This skill type category includes management, professional and technical occupations related to the arts and culture industries, including the performing arts, film and video, broadcasting, journalism, writing, creative design, libraries, and museums. It also includes occupations in recreation and sport.

Sales and service:
This skill type category contains sales occupations, personal and protective service occupations, and occupations related to the hospitality and tourism industries. Sales and service management occupations are also included in this category.

Trades, transport and equipment operators and related occupations:
This skill type category includes construction and mechanical trades, trades supervisors and contractors, operators of transportation and heavy equipment, and related management occupations. These occupations are found in a wide range of industrial sectors, with a large percentage occurring in the construction and transportation industries.

Occupations unique to primary industry:
This category contains occupations that are unique to primary industries (mining, oil and gas production, forestry and logging, agriculture, horticulture, and fishing).

Occupations unique to processing, manufacturing and utilities:
This category contains supervisory and production occupations in manufacturing, processing, and utilities.

The NOC matrix

The NOC matrix is a table constructed with the skill type categories represented in columns 0 to 9 from left to right and the skill level categories represented in rows A to D from top to bottom. This graphic overview allows users to quickly locate and identify NOC minor groups, and displays how groups are related with respect to the two main criteria.

NOC Implementation

The NOC has been released as a two-volume set, consisting of the classification structure, descriptions of the 522 unit groups, a copy of the NOC matrix (which offers an overview of the classification), and an index of occupational titles that are classified in the NOC. A career guidance version of the NOC, which will include various descriptive ratings of occupations, such as physical requirements and environmental conditions, will be available in the spring of 1994. Plans are also underway to release the NOC in electronic format.

The National Occupational Classification was implemented in Canada Employment Centres in May, 1993.

Ohio's Adoption of Canada's Jobscan Skill Checklists

Dixie Sommers
Ohio Bureau of Employment Services

It is a great honor for me to participate in this prestigious meeting about the future of occupational classification. It is also a great honor to share in this panel with my colleagues from Canada. I believe my presentation will illustrate our debt to the work of Employment and Immigration Canada.

For purposes of this presentation, I will view occupational information and classification from the perspective of a very specific and practical question: What kind of employment service should Ohio have for the 1990's?

My agency, the Ohio Bureau of Employment Services, operates the public labor exchange for our state. Ohio has a population of about 11 million and a labor force of 5.5 million. We are a typical midwestern industrial economy, based on steel, motor vehicles, and metalworking industries, making the difficult transition to a service economy.

In 1990 the Bureau celebrated 100 years of service, marking the centennial of the first public employment service in the nation. Our agency receives job openings from employers, and applications from job seekers. We match job seekers and job openings, and do screening and referral of individuals to employers. Employers provide their job openings to us voluntarily, and most applicants are also voluntarily seeking our help. (Some unemployment compensation recipients are required to register with us, as are some recipients of public assistance.)

Our services are funded by employers through a Federal tax, and we are part of a decentralized national Employment Service program. Decentralization means that each State conducts its program somewhat differently and we have different computer systems and matching processes. We share many common tools and serve national markets through the interstate job bank system.

Like many public organizations, during the 1980's Ohio's employment service faced many challenges. We dealt with severe budget pressures, a transformation of our economy and the needs of our customers, and changing technologies and the new opportunities they provide. We also saw national challenges to the role and existence of the public labor exchange, and general neglect of the program at the Federal level.

These conditions brought Ohio to renew the mission of the Employment Service by adopting six themes for service delivery. We decided that Ohio's Employment Service would:

1. Provide customer access to information about jobs and job seekers,
2. Provide customers the choice of self-service,
3. Focus on the job-ready customer,
4. Use skill-based information about jobs and job seekers,
5. Use staff and technology appropriately, and
6. Use performance standards which support the themes for service delivery.

These themes have served as the basis for a $17 million investment in a new computer system for the Employment Service—Ohio Job Net—and for a change in the way we deliver our employment services. The new system and service delivery will be implemented beginning in the Fall of 1993.

Theme 4, using skill-based information about jobs and job seekers, speaks to the importance to our customers of making a high quality match of jobs and people. A good match is of course important to employers, who want referrals of individuals with the qualifications they require. A good match is also important to the individual job seeker's career opportunity, earnings potential, and minimizing the risk of failure in a new job. A good match is important to our agency because it is our "product"—it is what we have to offer to our customers.

Performing a good match requires good information about the requirements of the job and about the characteristics of the job seeker. Good information is:

Consistent from job seekers and employers. Consistent information uses similar terminology, level of detail and common measurements, and can be gathered consistently by a large number of diverse users.

Easy to use by staff and customers. Easy use enhances consistency of application, and is critical as we move toward self-service by job seekers and employers.

Low in data entry and computer processing burden. Limited resources require that data entry be quick and that the computer processing power needed to conduct an on-line match be reasonable.

Reflects current and changing job requirements. The information for the match must capture changes in job requirements as technology and work organization.

Useful for labor market analysis. The information used in the labor exchange should yield data with enough detail and in a structure to allow analysis of skill requirements, skill mismatches, training requirements, and overall labor market trends.

How is job matching to be done? What alternative methods are available and what information do they use? To answer these critical questions, we gathered information on methods used in other States and Canada, as well as in the private sector. We found that there are generally four alternative job matching methods:

- Dictionary of Occupational Titles Code or other code matching
- Keywords
- Text search
- Checklists

Each of these methods has its advantages and problems in light of the characteristics of "good information" for job matching I have described.

Dictionary of Occupational Titles code matching

Matching job openings and job seekers according to the *Dictionary of Occupational Titles* (DOT) code assigned to them is the most widely used matching method in the U.S. public employment service. As with the other methods, this matching is the first, but critical, step in the matching process. It narrows the pool of applicants to be considered for a job opening, leading to review of other characteristics of the job seeker in comparison with the job opening (for example, wage desired compared with wage offered, and review of detailed job requirements and job seeker qualifications). DOT code matching is the method Ohio is currently using.

DOT code matching has several problems:

Consistency hard to acheive. Consistency depends on accuracy in selecting from among the 12,000 DOT codes for each job opening and each job seeker. This coding is performed by many individual staff, leading to intercoder reliability problems. In addition, coding decisions are complicated by the inconsistent amount and quality of information, and frequent lack of fit between the level of detail in the DOT and the scope of the jobs and characteristics of the job seekers. In practice, the large number of DOT codes and difficulty of code selection have led to use of "cheat sheets" by employment service staff—a list of commonly understood and commonly used codes rather than selection from the entire list of 12,000 codes. The difficulty of consistent coding when staff use their own unique short lists of codes is easily seen.

Out of date and not dynamic. Perhaps the most widely cited limitation of the DOT is that it is sorely out of date. The most recent "Revised Fourth Edition" was published in 1991, and provided fairly minimal revisions from the original Fourth Edition published in 1977, over 15 years ago. Users familiar with the methods used to develop the DOT understand that the analysis underlying the 1977 edition is even older than the publication itself.

Given the current structure of the DOT and its development methods, there is no practical way for a state employment service to capture changing job requirements we see in job orders and have these quickly incorporated into the DOT.

Does not provide information on qualifications and requirements for labor market analysis. To understand the changing skill requirements of jobs, and apply this information to policy and curriculum for training programs and to counseling job seekers, we must have more than job titles and codes. The current DOT code matching method provides us only with titles and codes. The details are buried in the narrative provided by employers and job seekers, which does not translate well into data for analysis. Additional details are provided in the DOT descriptions and characteristics associated with each code, but we presently have no means of associating this information with specific jobs and job seekers. We do not know, from a database viewpoint, whether a specific job opening has all or part, and which part, of the experience and characteristics contained in the relevant DOT description. In short, the DOT code matching process does not generate a database which is useful for analysis of changing skill requirements of jobs and skill characteristics of job seekers.

A variant on the DOT code matching method is to use a different occupational classification for code matching. The most obvious option is to use the Occupational Employment Statistics code. This addresses the consistency problems, as far fewer codes are involved. However, the other problems with the DOT matching method remain.

Keywords and text search

Some State employment agencies have dealt with the problems of the DOT code matching process by turning to the use of keywords and text search methods. These are two different methods which are similar in that they rely on the computerized search of information on job openings and job seekers for common terms. For example, the computer may search job openings and job seeker information to find those which share the words, "oxyacetylene welding."

Keywording and text search methods do a better job than DOT coding in reflecting current and changing job requirements. Text search relies directly on information provided by employers and job seekers, which is by definition current. Keywording can be kept up to date relatively easily by continuous revision of the keyword lists.

While these two methods have some advantages over the DOT code matching method, they also have limitations.

Consistency hard to acheive. Consistency is easier to achieve with keywording than with DOT coding, as a specific list of keywords is provided for employer and job seeker use. In text search, consistency depends on use of common terminology by employers and job seekers as they independently describe job requirements and qualifications.

Hard to use. Keywords are rather cumbersome for employers and job seekers to use because they must refer to a list of keywords which has been developed for a job category. Text search depends on both the employer and job seeker providing sufficiently detailed narrative information. While most employers may be expected to have job descriptions, job seekers may not be skilled at writing narrative about their work experience.

Data entry and computer processing burden. While the data entry and processing burden for keywording is manageable, the burden for text processing can be significant. Text processing depends on entry of text as a data file, using either key entry or optical character recognition. Most job seekers served by the employment service do not have formal resumes, but instead provide hand-written narrative on the forms provided. Reliable and inexpensive optical character recognition technology for handwritten material is not yet available.

Skill checklist

The checklist method addresses all of the characteristics of "good information" for job matching, albeit with some limitations. The advantages of checklists are:

Consistency achieved within an occupation. For a particular occupation category, the same checklist is used by both the employer and job seeker, thereby insuring use of consistent terminology and descriptions. Inconsistency may still occur because of differences in interpretation of checklist items.

Easy to use. Checklists are comparable to keywords in being somewhat cumbersome to use in hard-copy form because of the number of checklists from which a selection must be made. Ease of use is improved by self-service computerized access to only the needed checklists, and by organizing the checklists in disposable booklet form for hard-copy use.

Light data and computer processing reqiurements. Data entry consists of the checklist identifier and one keystroke for each item checked. Processing requirements for matching are trivial, as checked items are treated as alpha-numeric data which are sorted and compared.

Can reflect changing requirements. Checklists are formatted to allow employers and job seekers to enter new items as technology and other job requirements change. These items can be captured in a database and analyzed for possible addition to the list. Also, usage of list items can be analyzed and unused items can be dropped.

Provides information on qualifications and job requirements for labor market analysis. Because checklists capture detailed information on job requirements and job seeker characteristics, they can facilitate analysis of changing skill requirements and skill mismatches. Additional development will be needed to realize this potential.

What is a checklist?

Generally, a checklist is a list of the information about a applicant's experience and qualifications which an employer needs for making a hiring decision. It is a "checklist" because its format allows the user to check specific items.

After reviewing the alternative methods for job matching, we in Ohio made a strategic decision to use the checklist approach. We believe the checklists will provide better information, and therefore result in better quality matches for our customers. In our new computer system, checklists will be the primary matching tool. We will continue to use the DOT code matching for occupations for which a checklist has not been developed, generally in occupations for which Employment Service activity is small. The DOT will also be used for reporting purposes and for coding job orders sent to the interstate job bank.

Employment and Immigration Canada provided to us copies of their checklists, which were in various stages of development. Most were completed, but several were in draft form. Before adopting the JOBSCAN checklists as a starting point, we reviewed their coverage of Ohio's economy. This was accomplished by relating each of the JOBSCAN lists to the Occupational Employment Statistics (OES) classification, and tabulating the employment in the related OES categories. We also tabulated the number of job openings and job seekers in our Employment Service files, using the DOT codes related to the OES categories. This analysis showed that the JOBSCAN checklists covered 84 percent of employment, 88 percent of job openings, and 90 percent of the job seekers in Employment Service files.

We have been working over the last year on a project to modify the JOBSCAN checklists for use in Ohio. This project has several components:

Change to U.S. spelling and terminology.

Change to U.S. and Ohio training and credentials. We have removed checklist items which refer to Canadian-

specific training programs, certificates and other credentials, and replaced these with appropriate U.S. and Ohio items.

Fit into U.S. occupational classification (Occupational Employment Statistics classification). Because we need to use the information gathered on job openings and job seekers for labor market analysis, we decided to organize the checklists to fit the OES classification system, with some collapsing of OES categories. We are calling the resulting OES-like codes, "Job Service Occupations" or "JSO's" to avoid confusion with the pure OES codes. The JSO codes will be used as the starting point of the match. That is, the match will use checklist items for job seekers and job orders which are assigned the same JSO code. The JSO code also will facilitate comparison of employment service activity with employment data, and will be used as an aid in assigning DOT codes to job orders and job seekers for reporting, interstate job bank, and other purposes.

Employer review. Following the advice of Employment and Immigration Canada, we are conducting an employer review of the draft Ohio checklists. This is being done through a mail review to a sample of employers who have filed job orders with us in occupations covered by each individual checklist. Employers are asked to review checklist items for appropriate terminology and suggest whether items are useful to them and whether other items should be added.

Field testing. We are planning a field test of the draft checklists with job seekers. This test will focus on the ease of use and understanding of terminology, helping us determine the final format of the checklists.

Limitations of checklists

Despite our confidence and enthusiasm for the checklists, we have found that they do have some limitations, at least in their present form.

Ad-hoc development approach. Canada purposely did not impose a particular structure as they developed the JOBSCAN checklists. Their guiding principle was to find out from employers the answer to the question, "What do you need to know to make a hiring decision?" While this approach allowed for inclusion of a variety of information, it produced checklists which have a certain "ad-hoc" quality. The JOBSCAN checklists vary in length (from 2 to 11 pages), and do not have a standard format or a standard grouping of checklist items within each list. We are aware that Canada is working toward some standardization of the checklists.

Lack of consistent items across checklists. Lack of standardization in the development process has resulted in differences in wording and format of similar items across checklists. Thus, the checklists as currently developed do not lend themselves to the creation of a "skill database" which would facilitate skill transfer across occupations and be very useful for labor market analysis. We believe this problem can be solved by further refinement of the checklist items as they are used in the field.

Paper-copy use somewhat cumbersome. The paper-copy checklists are somewhat cumbersome. In Ohio we will have 70 separate checklists. We are planning to "package" them in booklet form for groups of occupations, to avoid maintaining stocks of 70 separate forms in our offices. As we move to self-service computer systems, the checklists will be shown as screens on the system, eliminating the need for hard copy for self-service users.

DOT coding still needed for some purposes. As I have mentioned, we will still need to use the DOT codes for several purposes. This is not a limitation of the checklists, but rather a reality of the U.S. public employment service environment. The DOT is still the norm, and is required for several purposes unrelated to job matching.

Current status

We are nearing completion of our adaptation of the Canadian JOBSCAN checklists. At this point we have completed the spelling, terminology and training modifications, and the fit with the U.S. occupational classification. The employer review is underway, and field testing has yet to start.

Implications of Ohio's adoption of Canada's JOBSCAN skill checklists

We see the implementation of use of the checklists in Ohio not as the end, but rather as a beginning for future development. In Ohio we are aware of a number of other States that are moving in the same direction, and States that are watching our work. We at the state level are undertaking this work because our national matching tool—the DOT—is no longer up to the job, and we cannot wait for national action on replacing it. We must continue to serve our job seekers and employers.

Ohio's adoption of the checklists moves in the direction recommended by the Advisory Panel on the Dictionary of Occupational Titles. We will be using a common classification system for our Employment Service and our labor market information, by fitting the checklists into the Occupational Employment Statistics classification. And we are moving toward a database of skill information, although much more refinement of the checklists is required to accomplish this.

Should the U.S. Department of Labor move forward with the Advisory Panel's recommendations, the resulting database will allow Ohio and other states to develop checklists and other matching tools which reflect a valid and current national database, greatly improving our employment service activities and our labor market analysis capacity.

Innovations in Occupational Classification: International Lessons for Revising the United States Standard Occupational Classification System

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This paper evaluates various national and international occupational classification systems in terms of what can be learned from these structures. It also looks at other countries' experiences in developing them, as the United States gets ready to revise the U.S. Standard Occupational Classification (SOC) system. This analysis does not describe other national systems in detail,[1] but rather seeks to clarify their implications for Standard Occupational Classification (SOC) system and *Dictionary of Occupational Titles* (DOT) revision activities. Due to the availability of translated materials, this examination focuses on the following national systems: Australia, Canada, France, Germany, Japan, the Netherlands, Sweden, and the United Kingdom. In addition, the characteristics of the current International Standard Classification of Occupations (ISCO–88) and its utility as a model for the U.S. occupational classification system are also discussed.

The paper is organized into four major sections: Section one discusses the rationale behind looking at other national and international occupational classification systems. The second part sets forth a number of terms that are commonly used with regard to occupational classification but that do not seem to have universally-accepted definitions. The third section examines the most recent version of International Standard Classification of Occupations (ISCO–88) in terms of its underlying principles, coverage, and consistency. It further looks at the extent to which ISCO–88 is modeled in other national occupational classification systems and whether it is a suitable or desirable model for the revised U.S. SOC to mirror. The final portion of the paper synthesizes lessons from other national occupational classification structures in terms of underlying principles, development methods, evenness of coverage and detail, links to educational and training systems, and particularly the outcomes of efforts aimed at developing unified occupational classification structures that serve both statistical and transaction (employment services) purposes.

Why Look to Other National and International Occupational Classification Systems?

As has been the case in the United States, many other nations also have been facing rapid technological and structural changes that impact on the nature of work and occupations. This has led to a greater focus everywhere on workforce quality, occupational skill requirements, and training systems. This increased focus on human resource issues has led to a recognition of the importance of occupational information, as a means both to assist effective career development and to understand trends in the structure and quality of jobs. In this context, many other countries have recently revised their national occupational taxonomies with a view to get added value from their systems.

In most countries, the primary use of occupational information is to guide career choice and preparation. A secondary use is sociological and economic research to answer questions about social stratification, the quality and distribution of jobs, returns to "human capital" (Becker 1964), and so forth. The focus on occupational information in all countries has intensified recently as economic globalization and increased competition has highlighted the importance of workforce skills and training to competitiveness, and people increasingly want to know whether there is a match between the supply and demand for skills in the national economy. As a result, a number of nations have revised their occupational classification systems, some in major ways. This also has been in response to the frequent criticism that multiple incompatible occupational classification structures, that provide only part of the information users want, cannot answer fundamental questions about the relationship between occupational demand, qualification, and supply. As the U.S. occupational classification and information system faces the same criticism, it makes sense to take lessons for the U.S. SOC revision from those who have gone before.

When examining the role of human resources in economic "competitiveness," it has been common of late to look to Germany and Japan, countries that both have been successful exporters during the 1980's and are seen to have highly-skilled workforces. These two countries, however, have little to offer in terms of innovations in occupational classification. Upon reflection, this is less surprising than it might initially seem. Although differing in form, the German occupation-based apprenticeship system and the Japanese enterprise-based training system, along with close links between firms and schools, both provide their nations with well-developed mechanisms for skill development and school-to-work transition. As a result, these societies seem to have a better understanding of and agreement about what an "occupation" is and what its skill and training requirements are. Over the past two decades, neither Germany nor Japan has made any major adjustments or innovations with regard to their occupational classification systems.

In fact, it seems to be in advanced market economies that have less well-articulated school-to-work transition and skill formation structures that occupational information, and hence occupational classification, receive the most attention. It makes sense that these publicly-developed occupational and career information structures have emerged to fill a gap that exists with regard to private and public training, career development, job transition services, and other labor market institutions. Given that these labor market institutions are scarce in the United States as well, it makes more sense to look toward occupational classification systems developed in countries with similar labor market institutional structures, countries that will need to address similar problems. Thus, while references will be made to a number of other systems, the primary focus will be on Australia, Canada, the Netherlands, and the United Kingdom.

The interest in examining international occupational classification systems appears to stem from the increased internationalization of national economies. With the establishment of the European Community, discussions over a North American Free Trade Agreement, and the increased international mobility of labor, issues of labor migration have come to the fore in U.S. policy debates. There may be an increased need for cross-national agreement on occupational definitions to facilitate formation and implementation of policy in this area.

Concerns about workforce "competitiveness" have also led to increased interest on the part of researchers and policy makers about the structure of work organization and occupational employment in other countries. More comparable occupational data is necessary to shed light on how the development and use of human resources varies across national boundaries.

Even now, a number of national occupational classification systems, including the 1980 U.S. SOC, have as one of their principles to be compatible with the International Standard Classification of Occupations. In reality, however most advanced market economies have occupational classification systems which differ in important ways from ISCO. If the United States considers the development of internationally-comparable data to be very important, it clearly requires a closer examination of the ISCO in order to determine whether national requirements for occupational classification systems should be subordinated in the interests of developing internationally-comparable statistics. Given differences in cultures, definitions of "occupations," and differences in survey scope and methodology[2] among nations, one might ask whether using the same classification structure could even produce internationally-comparable occupational data that is valid.

Principles of Classification and Terms of Reference

Many terms used in debates related to occupational information are not well-defined, or are defined differently, by their users. The following section discusses some of the frequently-used terms.

Embury (1991) describes the steps that must be followed to develop an occupational taxonomy as follows:

> To develop a classification, one must first identify the *objects* to be classified; one must select those *attributes* of the objects which are relevant for one's purposes; one must define the objects precisely in terms of those attributes; one must define a *relation of similarity* between the objects in terms of those attributes; and one must apply this relation to *group* the objects into successively broader categories (Embury 1991: 9, emphasis added).

In the context of occupational classification, the objects or units to be classified appear obvious—occupations. This seems simple enough, except that the term "occupation" can mean different things to different people, even within the same country. For example, the U.S. *Dictionary of Occupational Titles* (DOT) contains more than 70 different types of sewing machine operators, distinguished from each other only by the particular type of machine they operate; whereas, the Occupational Employment Statistics (OES) classification structure defines occupations more broadly, having only three types of sewing machine operators, one each for garment, nongarment, and shoe making.

Certainly one would not expect greater consensus across national borders. Whereas, the United States distinguishes numerous managerial specialties as distinct occupations (for example, the OES structure has 19 such specialties not counting residual categories), the German structure has but a handful of distinct managerial and administrative occupations. Certain terms do not necessarily mean the same thing in different countries, even

those that share a common language. For example, in the United States the term engineer is applied narrowly to individuals assumed to have more theoretical university training (a minimum of a bachelor's degree) in an engineering field; whereas, in Australia and the United Kingdom, the term engineer also applies to various skilled tradespersons.

There is also the difficulty of distinguishing between occupations and "jobs."[3] Historically the term "occupation" has been linked to the notion of crafts or professions and the totality of an individual's work-related capabilities. Thus, occupation is related to what a person is, not merely what he or she does, implying a portability of the individual's skills and capabilities across jobs. A job, on the other hand relates only to what a person does based on status as employee. As Ehrenstrom (1983: IX) notes, confusion arises because almost all classification structures have characteristics of both occupations and jobs. In ISCO,[4] as in most national occupational classification systems, the units defined are broader than jobs, but they are similar in that they are based on work performed in advanced economies and industries, with occupations representing groups of similar jobs. Given the tremendous variation in work organization between countries, industry sectors, and even firms, it is understandable that there is ambiguity surrounding these terms.

Although national occupational classification structures vary due to industrial, cultural, and other differences, they are all either based on or derived from work performed; that is, they emanate from a country's job structures rather than individual's professed capabilities. This is important to remember when thinking about the appropriate attributes on which to base an occupational classification system.

Recently the primary debate in the U.S. has centered around whether occupational classification should be based on "work performed" or on "skills." This is not the either/or dichotomy that it seems to be, as all national skill-based occupational classification systems are derived from work content. The real distinction in debates over skills-based classification should be whether the system is derived from skills possessed by the individuals (skill supply) versus requisite skills for effective job performance (skill demand).

Given current classification structures and data availability, most economists focus on the individuals' average education levels as proxies for skill level for various occupations. The problem with determining the occupational skills from the supply-side is two-fold: 1) Individual workers, even those performing the same jobs, possess a never-ending combination of skills and capabilities (as varied as the human species itself) and it is difficult to discern whether and when these abilities are used in the course of work performed. 2) Although household data on educational attainment provides information on general *levels* of skill or human capital, it does not provide information on skill type or specialization. For example, a metallurgist and a psychologist may have similar levels of human capital, and may both possess problem-solving and communication skills, but obviously each occupation requires training in its specialized field of knowledge.

Most users of occupational data in the United States, who are not in fact economists or other social science researchers (WESTAT 1993), want information about both skill supply and demand. However, given the focus of most users on career guidance, program planning and job placement, most people want to know about skill demands in order to try to match supply. Methodologically it also would be easier to determine occupational skill levels and types through employers. As in the case with other countries, then, it seems to make sense to determine occupational skills based on those that are necessary for effective performance on the job.

Is ISCO–88 an Appropriate Model for the United States?

The main aims of ISCO–88 (ILO 1990) are to: 1) Facilitate international communication about occupations by providing a statistical tool; 2) provide a basis for producing international occupational data in a form useful for research as well as decision-making activities (for example, international migration and job placement) and 3) to serve as a model (as appropriate, not to be adopted wholesale) for countries developing or revising their national classification systems (ILO 1990: 1).

Of the 117 countries that have some sort of occupational classification system, most use ISCO or a minor national adaptation thereof for statistical purposes requiring complete coverage of all jobs in the economy (Hoffmann 1991: 2–3). Most advanced market economies, such as the United States, however, have developed their own unique classification systems. ISCO appears to provide a useful conceptual starting point for countries that lack the resources to develop a classification structure reflecting their unique economic structure. Although most countries that have a unique national occupational classification system state that compatibility with ISCO is one principle of classification (for example, the 1980 U.S. SOC and the 1990 U.K. SOC), it appears to rank low on lists that have multiple classification principles.

In general, for most countries, the value of internationally-comparable occupational data appears to be less important than the need for a national classification structure that is easily understood within national borders. Form should follow function in classification as elsewhere, and the major users of occupational information in the United States are not international researchers, but rather are

those involved with job placement, career guidance, and program planning for training and development.[5]

For the ISCO–88 to provide a compelling model, it would need to have underlying principles that would provide value added beyond current national occupational classification systems. ISCO–88 diverges from previous editions in its use of skill level, a function of the complexity of work tasks required, and skill specialization, defined by the worker's field of knowledge, as principles of aggregation. Since jobs are specified as the unit of classification, the operational measure of skills is to be those required for effective job performance, not those possessed by an individual worker (who may be either under or over employed).

ISCO has four skill levels, based on years of formal education or vocational training: 1) Primary education; 2) secondary education, including apprenticeship; 3) post-secondary education, not university; and 4) university degree including post-graduate.

Major occupational groups each have one skill level, as well as a major skill specialization, attributed to them. Skill measures, reflecting work content, should be assigned at the greatest level of occupational detail and then aggregated into homogeneous groups. One difficulty with applying the detailed ISCO groupings across national contexts is that different countries have varying educational and skill requirements for (seemingly) the same occupations. In addition, from the U.S. perspective, ISCO–88's major groups appear to be somewhat heterogeneous with regard to both skill level and skill specialization. In fact, the "skill-based" hierarchical structure of ISCO–88 does not look so different from standard "work content-based" occupational classification structures. If this is the case, ISCO would seem to provide little added value, in terms of providing an indication of an occupation's requisite skills and qualifications, over the current U.S. classification structures.

Nonetheless, ISCO–88 provides some useful general guidelines for the SOC revision process. Similar to a number of other countries, the United States may want to consider ISCO's underlying classification principles of skill type and skill level as the basis for the new SOC. Also, it would seem reasonable to base the operational measures of skills on those required for effective job performance, as ISCO–88 does.

Synthesis of Lessons From Other National Occupational Classification Systems

National classification systems generally have been developed to serve one or both of two purposes: to provide a framework for the production of statistical data, and to serve as an instrument for employment service operations (Hoffmann 1991). Historically, similarities have been greater than differences between developed market economies with regard to occupational classification systems, occupational dictionaries, and occupational information tools. Most of the countries examined traditionally have had occupational dictionaries, developed for employment service-type activities, that are separate from occupational classification systems used for statistical and labor market information purposes. (The Netherlands and Canada provide exceptions in that they each have had an integrated structure for some time. Also, Germany has its own unified structure.) In addition, most nations have varied tools for career and vocational information and program development that are derived from a mix of sources. Typically, each of a nation's classification systems was developed by its primary users with little sustained effort to achieve compatibility or comparability between them. Although crosswalks between different classification systems usually were developed after the fact, as has been the case in the United States, users have rarely seen them as adequate.

As was the case for the U.S. DOT, other national dictionaries were developed from the "bottom up" through expensive and extensive job analyses, mostly within enterprises. Specification of detailed occupations was weighted towards manufacturing and production occupations which were dominant in the early post-war period. Some countries, particularly English speaking nations, tended to borrow other countries' dictionaries before they had their own. Initial versions of dictionaries usually were developed between the 1940's and the early 1970's.

Most statistical occupational classification systems were developed to serve the needs of population censuses. These structures usually were developed from the "top down" according to analytical principles. Occupational categories tend to be fewer in number and broader than those in dictionaries, and they provide little information other than occupational title, alternate titles, and a brief description of tasks. Occupational coding is based on these items. Aggregation principles often appear to be heterogeneous within the same system—a mix of tasks performed, function, industry, and education or training required.

The section that follows will highlight some innovations in occupational classification that have occurred over the past decade. The dominant trends include a movement towards more replacement of multiple, fragmented classification systems with a unified structure, as well as a shift in the basis of classification towards an explicit recognition of occupational skills.

Basis of classification

In the past, both occupational dictionaries and statistical classification systems were based on the concept of "work performed," or job tasks. Recently there has been a movement in many countries toward using a concept

of "skills transferability" as the main principle of occupational classification systems. The rapid pace of change in technology and work organization world-wide has led to a greater focus on issues of human resource development and worker (re)training. As a result, there increasingly have been calls for, and action taken to, reform national occupational information systems to serve these purposes. From the mid-1980's to the present, a number of countries have been implementing "skill-based" occupational classification structures: The Australian Standard Classification of Occupations (ASCO), the Canadian National Occupational Classification (NOC), the Netherlands' 1992 version of the Central Bureau of Statistics' Occupational Classification, and the United Kingdom's Standard Occupational Classification (SOC).

Following a skills-based approach, occupations essentially are groups of jobs with the same set of skills, rather than those that perform precisely the same set of tasks. Within the ASCO system, workers in the same occupation are supposed to have within-group mobility; that is, if they are performing one job within the group effectively, they are expected to have the skills necessary to perform another within the group, without needing to undergo extensive retraining. Combined with newly developed computerized vocational guidance and job matching systems, it is hoped that this new approach will solve one of the deficiencies of prior matching systems based on dictionaries similar to the DOT—that workers could not be matched to different jobs or occupations that require skills similar to those the worker possesses.

Level of detail

Most of the newly developed and unified classification structures distinguish among fewer, broader occupations to cover the entire economy. This shift reflects changes in the world of work where new technology and work organization has led to broader responsibilities, and a skills-based approach shows many lower level jobs requiring similar sorts of skills. (For example, in the Canadian JOBSCANS system, merely one skills checklist covers what were 2,200 distinct occupations in the former Canadian Classification and *Dictionary of Occupations.*) At the same time, there have been attempts to provide greater detail among the higher skilled occupations that require extensive specialized training. The newer and revised national classification systems are more similar to the U.S. SOC than to the DOT in terms of size, that is, number of detailed occupations: the numbers range from a low of 371 (United Kingdom's SOC unit occupations) to a high of 1,212 (The Netherlands' CBS 1992). Some have unit groups of occupations as the lowest level of detail, while others have occupations as the most detailed category. For unified classification structures, statistics are often published at the unit group level, with the more detailed occupational level used for employment service purposes (for example, job placement).

Traditionally, descriptive material for classification structures has been limited to unit titles and related job titles and short definitional statements. Newly revised skill-based classification structures, such as ASCO and the Canadian NOC, have developed more comprehensive statements including tasks and duties, typical working conditions, skill requirements, and types of training typically needed.

Aggregation structure

The newer skill-based national occupational classification systems generally have four levels: The most aggregate, major group or division, is distinguished by "skill level," which generally refers to years of formal education and training. In reality, some of the distinctions are functional as some of the major groups have the same basic educational requirements (for example, clerical and administrative occupations versus sales and service). The second and third levels (sub-major and minor groups) of aggregation are usually distinguished by "skill specialization" or "skill type" and refer to the field of work (essentially derived from work performed); and the fourth, most detailed level should contain occupations that are homogeneous in terms of skill level and skill type, if not worker function.

Canada has pioneered a new approach with its National Occupational Classification (NOC) System. Rather than arranging occupations in a pyramidal, hierarchical structure, based on a combination of skill level and skill type, the NOC is organized in matrix form. On the vertical axis is skill level, and on the horizontal axis, skill type. As a result, the matrix structure has the advantage of distinguishing more homogeneous cells, or groups of occupations, in terms of their skills attributes; whereas, skill level and skill type are less well distinguished with hierarchical classification structures.

Degree of unity among occupational classification systems

Increasing emphasis on human resource issues in all countries has placed an emphasis on rationalizing occupational information systems by bringing labor demand and supply information into line. In addition, rapid technological and organizational change has rendered obsolete parts of many national occupational classification structures and definitions. Most nations' original occupational classification systems reflected the narrow, segmented nature of jobs under Tayloristic regimes that dominated manufacturing during much of the post-war period. Revised national occupational classification systems have shown a trend toward using fewer, broader occupational classifications, rather than focusing on detailed jobs. In line with the increased emphasis on skills and training, many countries have sought to collapse the number of lower skill occupational categories and to break out and

refine those that require extensive education and specialized training. Additionally, revised systems have tried to present balanced, representative structures, replacing ones that formerly overemphasized manufacturing sector occupations.

There have been efforts to develop a unified framework for occupational classification and information to replace their previously fragmented systems in many countries that did not have an integrated structure already. While different users of occupational information continue to need different types and levels of occupational detail, there appears to be no reason why various sources cannot be tied to the same basic classification structure to ensure comparability at least at some levels. The experiences of other nations show that multiple agencies and organizations—with employment services and statistical agencies as the primary actors—can come together to develop and implement these systems. A number of unified systems have been implemented or revised over the past decade: in Australia, Canada, the Netherlands, Sweden, and the United Kingdom, and the French seem to be attempting to do the same with the new *Repertoire* Operationnel des Metiers et Emplois, (ROME, Bertrand 1991).

In the United States, different occupational classification structures are used for state career information delivery systems, health and safety reporting and statistics, employment service transactions, and gathering of occupational employment statistics. On the other hand Australia, Canada, the Netherlands, and the United Kingdom, among others, now use their unified structures as the basis for multiple occupational information needs.

The United States is now looking to streamline employment services, job training, and other employment assistance programs, providing "one-stop shopping" for employment service clients. Rationalization of service provision will highlight further the importance of having a unified occupational classification system over the currently fragmented structures in which a myriad of different classification structures are used for labor market information, employment service job placement, career development information systems, training program planning and assessment, and so on.

At this point, it is difficult to assess the success of various unified national classification systems in meeting diverse user needs because most of these efforts are of recent origin—essentially from the mid-1980's onward. But if success is judged by the ability to form consensus and to implement the new classification system across a variety of programs and agencies, then the evidence seems to indicate that this can be done across a range of countries, or environments. This implies that it also should be possible for the United States to develop and implement a unified classification structure, through interagency participation, coordination, and consensus.

Development methods and maintenance

Only a few countries (Australia, Canada, and France) have recently used (or tried to use) wide-scale surveys, properly conducted job analyses and interviews with job holders, and consultation with industry associations, trade unions and other representative bodies as the basis for substantial revision to their occupational classification systems. These programs have been quite costly and time consuming. It is more common for countries to take a top-down approach, using an older classification structure, such as ISCO, or another country's occupational classification, as a starting point and then calling upon national experts in different industries or areas of work to give information on the extent to which the model structures should be modified. Although most countries update their occupational information sources—such as career guidance, job placement, training opportunities—frequently, most countries do not systematically update or maintain their base classification structures.

The problem is that there is rarely a feedback loop to do so; that is, information on occupational change or emerging occupations is not systematically gathered or used to update or modernize the classification structure itself.[6] Various computerized job matching systems (such as the Swedish WAP 2000, the Canadian JOBSCANS, the Netherlands' FIT, the United Kingdom's SUPERVACS) collect a variety of information from employers on job openings that could be used to update occupational descriptions and classifications. Whether such links are becoming well-articulated is not yet clear.

Links to education and training

The effectiveness of the new classification systems, based on "skills transferability" concepts, in improving job matching and human resource development efforts remains to be proven. Despite the emphasis on skills transferability as the major principle underlying occupational classification, links between these new national systems and education and training curriculum appear to be weak.[7] One exception appears to be in Australia where post-secondary educational institutions are required to link each of their courses to one or more of the ASCO categories on the basis of principal occupations of graduates. Also, some of the ASCO classification structure itself reflects the current vocational training structure, particularly in the crafts and other traditionally apprenticed occupations.

In the United Kingdom, a tentative link has been developed between the new SOC and the National Vocational Qualification Framework (an attempt to develop national standards for occupational competence and training, similar to the fledgling efforts in the United States to develop national industry skills standards); however, the systems are not at this point compatible (Elias 1991).

In Germany, the occupational classification structure strongly reflects the apprenticeship system.[8] During the

last revision in 1990, the German census classification changed little due to a desire to maintain the time series. The area that saw the most significant change to structure was in the metalworking trades. During the mid–1980's, the apprenticeship training for metal trades was substantially revised, with 55 occupations consolidated into only 14, and the occupational classification structure was revised to reflect this (Macht 1992).

The Netherlands' Standard Classification of Occupations 1992 also is derived from the country's education and training structure. Skill level and skill specialization are defined within the structure as the level and type of the "most adequate training," based on the Netherlands Standard Classification of Education (see Bakker 1993).

Conclusions

By examining recent innovations in occupational classification in other countries, we can draw a number of lessons for the U.S. SOC revision effort.

Throughout the world, people are increasingly concerned with issues of labor market flexibility, workforce quality, and skill development. As a result, *a number of countries have revised their occupational classification structures so that they are based on models of skills transferability.* Users of occupational information in the United States as well place a premium on knowledge about the skill content of jobs. Revising the U.S. SOC in this direction may not be as major as it first appears: "Skill-based" occupational classification structures are not so different from those based on "work performed." *Other nations that have developed skill-based systems have derived each occupation's defining skill level and skill type from work content, not from the skills and capabilities possessed by various individuals holding the same job.*

As the new Canadian and Australian systems, among others, demonstrate, *it is both possible and desirable to create a unified occupational classification structure that meets both statistical and employment service needs.* Creation of such a unified structure may pose problems for some users of the currently-fragmented occupational classification systems in the United States; however, the value added from such a system will certainly outweigh the value lost.

The development and maintenance of a unified classification structure will require close and continuous interagency cooperation. The groundwork for such cooperation, particularly between the Bureau of Labor Statistics and the Employment and Training Administration, has been laid already during pre-revision activities leading up to the international occupational classification conference. In addition to this commitment, any serious attempt to move the SOC towards a skill-based occupational classification structure in the future will require considerable expenditure of resources to conduct valid and comprehensive occupational analyses.[9]

Finally, although internationally-comparable occupational data would be desirable, ISCO–88, as it is currently structured does not provide sufficient added value to compensate for the value lost in nation-specific detail. Thus, while looking to maintain some degree of comparability, *it would not be advisable for the U.S. to follow ISCO–88 closely, but perhaps use its underlying concepts of skill-type and level as the basis for a revised SOC.* We must remember that the primary users of national occupational information are those involved in career guidance, employment services, vocational training, and other program planning—activities that are still accomplished within specific national contexts.

Notes

[1] This has been done elsewhere—the Advisory Panel on Dictionary of Occupational Titles (APDOT), through its contract with Eivind Hoffmann and the International Labour Office, commissioned and received papers describing the national occupational information and classification systems of selected countries—and will be covered by presentations at this conference as well.

[2] For example, the U.S. occupational information system is based principally on a large survey of establishments by industry (the OES survey), because this data is considered to be more accurate than occupational data gathered through household population surveys; however, most other countries depend on household surveys for this purpose.

[3] For some people the term "job" is synonymous with "position." From my perspective, "position" means a particular employer's particular job slot, which is much too narrow an object for national classification systems.

[4] ISCO (ILO 1990) defines a "job" as a set of tasks and duties executed by one person and an "occupation" as a set of jobs where the main tasks and duties are characterized by a high degree of similarity.

[5] See Westat (1993) for a survey of users, their characteristics and needs, of occupational classification systems in the United States.

[6] The U.S. Bureau of Labor Statistics' establishment-based Occupational Employment Statistics survey is exceptional in this regard. In the OES survey, industry-specific forms with lists of appropriate occupations and their definitions are mailed to firms. If the respondent does not find the appropriate titles and definitions for all of his workers, he provides titles and definitions on a supplementary sheet. Information from these supplemental sheets is then evaluated by occupational analysts and used to refine and add emerging occupations to the OES classification structure.

[7] This is less so in all countries for professional and technical occupations, where educational requirements and certification are more well defined.

[8] In fact, one criticism could be that the structure is too reflective of the apprenticeship system, providing disproportionate detail for manufacturing and processing occupations especially, at the expense of sufficient detail among professional and emerging technical occupations. There has been some movement toward remedying this, however: the other major changes to the classification structure consisted of breaking computer and clerical occupations to provide greater detail and to reflect emerging occupational groups (Macht 1992).

[9] This is clearly articulated in the APDOT's final recommendations (APDOT 1993).

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Discussion

RONALD KUTSCHER: I think Richard Madden's comment on America's exploration for a new occupational classification system reminds me of the Winston Churchill comment that, "In the long run, America always does what's right, it's just that in getting there they pursue every other alternative first."

DANIEL WEINBERG: I have a question for Bart (Bakker). Can you talk a little bit about the historical continuity issue? It sounds like your new system is very different from whatever it was you had before.

BART BAKKER: Yes. Actually, it's very different. Some of our users want to make time series, so we thought to develop a coding system that makes it possible to make time series on the basis of the old classification and makes it possible to derive also the new classification.

So what we did is, made a cross-classification of both classifications, and make that our provisional codes.

Then you come to about 2,000 categories, and the coders code those categories, and after that we derive the old classification and the new classification, and you can make time series on the basis of the old classification.

It's more difficult to make time series on the new classification. I'm working on that now, and not on a very detailed level, on a level of 120 occupational groups. It seems possible to make time series from about 1970. Before that, the classification was so different and so less detailed that it would not be possible to make time series. But, a time series from 1971 up to 1993 is a very large time series for occupational data.

THOMAS SCOPP: I'd like to pick up on a comment that Mr. Madden made, you said that in Australia, at least, there would be almost guaranteed cooperation among the government agencies that would use your classification system, and you observed how we don't seem to have that kind of thing going on here.

I'm kind of curious. I noticed it reflected in some of the other presentations, too, that there does seem to be more cooperation among the other countries in using a standard classification.

Do you feel it's because, perhaps, there was more agreement to begin with on how to use the classification system? Is there some central authority that said you will cooperate? Or, is it just a reflection of a difference in national personalities, where, for example, the Australian people can get together and cooperate better, and we just have this undying need for 200 years in America to be independent or something here? I don't know. I'd like to get a number of observations on that.

RICHARD MADDEN: Well, that's a delightful topic you've opened up. Australia is a federal system. The government structure is largely modeled on the American one, you know, with an underlying of the Westminster tradition. But, we don't agree very well.

What is different, and the point I think I made at the beginning, is that we have a central statistical agency, and the purposes we are setting out with are statistical. And, we've had conversation over coffee about this, trying to clarify it. I mean, there are groups of people here who have not got statistical interest, they've got managerial interests about how you deal with labor force issues, very real issues, but they are different than the statistical ones.

The ABS (The Australian Bureau of Statistics) sets out with the statistical goal, and we invite everybody in. But, from our Employment, Education and Training Department would come the statisticians, who would, no doubt, then consult within their own department with all the other interests. But, the statistical focus would always be preeminent.

The second thing is, at the end of the day, it's the statistician in Australia that makes the decisions. So, the statistical framework is always going to be paramount, and I think that is the big issue.

We certainly see ourselves as being parallel to the Canadians and to the Netherlands in our structure. It's also clear with some of the other countries, but certainly I think the structure is very similar there.

BART BAKKER: The main reason we achieved success was that we make them co-makers, we consult them from the beginning, and consult them in every stage of the development of the classification. We ask them for comments, adjust the proposals, and do a lot of work for them, too, because they want to have statistical information to go into their own occupational information systems, and we have to deliver it to them. So, they need to integrate that classification scheme into their own systems.

OLIVIER BERTRAND: Well, in France, we have the two aspects. On the one hand, there is a legal monopoly for statistical surveys by the Statistical Office, but on the other hand, as far as the statistical classification is concerned, there has been a very comprehensive effort to involve everyone in the preparation of the classification, first, within a limited technical group, and then within a very large group with representation from all the social partners. So, there was an agreement on this classification and nobody is really questioning it.

Now, the tool that is being used by the employment agency is something else, it's their own internal tool, and the problem that will arise will be the problem of the relationship between statistics on job vacancies by employment agency on the one hand, and the statistics

by the Statistical Office on the labor survey on the other hand.

DANIEL KRYMKOWSKI: I think that one thing that has been missing from our discussions has been the treatment of the details involved with reforming occupational classification systems, aggregating more detailed categories into more highly aggregated groups and so on.

Along these lines I had a couple of questions for our guests from the U.K. As I understand it, the kind of basic atoms that you are working with consist of these 3,500 detailed occupational titles. Is that where things kind of started? That was my first question. I'd be interested to know, how that list was formulated, what kinds of analyses were done to come up with those detailed occupations, and then on what basis aggregation was done, on up and down the line to the 371 SOC job titles?

TESSA STAPLES: The 3,500 were part of the CODOT (Classification of Occupations and Directory of Occupational Titles) system, and through that structure, through that hierarchy, we attempted, when we did the Classification of Occupations in 1980, to do a bridge with the cause element of that and we developed these 350 operational codes.

We did publish in our classification how they related to the CODOT, but when we came to look at SOC, the building brick was our 350 operational codes from the 1980 classification.

RICARDO GARCIA: I have information about the occupational classification system that we use in Mexico. It has been been developed widely within our agency and includes research activities involving the branch activities of my country.

Our occupational classification system roughly has 25 percent covering agriculture, 20 percent with manufacturing, and the rest includes commerce and service occupations. The characteristics of the classification structure are determined by the economy of Mexico.

The structure is as follows, there are 19 main groups, and 137 subgroups, including approximately 10,000 different occupations. This occupation classification was revised for the last census, the 1990 census, and considered the Standard Classification 1988 and results from the 1980 census. Data from the census are combined with a special survey study of agricultural occupational employment. We also have two surveys investigating the informal sector that we produced in the last year.

So, we have valid information about occupational employment by sex, by level of education, by different working conditions, by size of the business unit, by incomes, and by fringe benefits, for example. We also have data on ability levels, and labor force participation rates. We have our monthly survey of employment and unemployment that covers only urban areas. Each month we obtain the unemployment rate and characteristics of employment by age and income.

PAM FRUGOLI: I have a question for Mr. Bakker. I work also on relating educational programs with occupations, and I wanted you to go into a little more detail on the issues that came up when you were trying to do that. How did you determine what the most adequate training was, because sometimes here the same training is offered at different levels, and it's hard to know which one is appropriate?

BART BAKKER: Well, it has been quite difficult to determine the most adequate training program in some cases.

First of all, I'd say that we have a national curriculum, that is to say, we know exactly what the level of education is when they come out of school, so we don't have differentiation as you have in the United States, according to quality of schools.

When you have a job title, and it seems plausible that there are two or even three training programs for entrance into that job, we just split it up, because we looked at what the complexity of the job tasks were, and the job title doesn't say, not in each occupation, anything about level of that occupation, but the tasks do.

So, for instance, social workers, we have on three levels, but they do different things. I may classify them differently, according to the level of the complexity of the tasks they do.

OLIVIER BERTRAND: I wanted to comment on this point because I heard some references to the idea of educational requirements for an occupation, and I find it a very difficult issue, especially since I'm working with countries, for instance, in North Africa, where they are hoping that their educational planning process could be assisted if there was a good classification giving the exact equivalency in terms of education.

And, frankly, I don't believe in that, and I think there is a supply effect which is very important, so that the situation depends very much on the local labor market and on the time since it is changing in every country with the increasingly high level of education.

If I take the example of the banks in my country, 20 years ago they used to recruit their agents at the starting level with something like 9 years of education, now they would like to recruit them with 12 plus 2, that is 14 years. It is just because they are available, there's employment. But, what is exactly the requirement for a bank employee, a teller? Nobody can say in an objective way.

And, for retailing, which I've been studying also, they used to recruit their supervisors without any specific educational requirement. Today, they would like also to have them with 12 plus 2 years of education, and nobody

can really say whether this is reasonable and whether it has a meaning or not.

But, at the same time, of course, you have to take that into consideration, but only at a very broad level. I think the problem is even more difficult at the international level, because the situation differs so much between countries.

SHAILA NIJHOWNE: I have a technical question with respect to the computer-assisted coding that you (Peter Elias) are suggesting. I know very well how important it is. Our experience in Canada is that if you have an automated system, which is only concerned with titles, you are able to code 70 percent of the responses, 50 percent of which are right, and the remaining 20 percent would have to be modified or changed, if you took the answers to the second question that we ask on our censuses, which is the tasks and duties performed.

I'd be interested to know whether the system developed in Britain is for both questions or only titles.

PETER ELIAS: There are some independent tests that have been conducted by colleagues of mine, which examine this particular issue.

I think I would respond by saying, if you've got information on a job title and task description, what are you doing using automated coding systems? This is not the material for automated coding systems.

Automatic coding is for those situations where the cost of coding is so high that material would not otherwise be coded, or where the quality of the information is so poor that to spend much time and effort in a computer-assisted framework would be a waste of resources.

So, I would say, always, we have to allow for human intervention in this process, and computer-assisted coding, where the coder is making the final decision, is undoubtedly the most reliable method and has the highest levels of validity.

However, we have been, frankly, surprised by how well computer-automated systems have worked. When they go wrong—and in our case it's about 20 percent of information that is incorrectly coded—they go spectacularly wrong. But, for that 80 percent which is right—right in terms of some independent assessment of where you'd assign a code to this information—it's very good, indeed.

So, if costs are important, and if that 20 percent is not really of any concern to you, then, of course, you'd go for computer-automated systems.

We expect that automatic coding will take place for applications where coding has not previously taken place. Examples of this are some of the leading insurance companies in the United Kingdom which have contacted us, because you know when you fill out any insurance form, whether it's for your car, your home, personal possessions, life insurance; they always ask you "What's your occupation?"; you always fill out that question on an insurance form. How many insurance companies code that information? The answer is, hardly any of them. They'll look at it to see whether you are a sky diver, or are engaged in some other perilous pursuit. They might look at it to see whether you are a teacher and they are going to give you some preferential rates or whatever, or what they really want is just something they can nail you with when you put in a claim in, so they can say it was a false claim because you gave them some false information.

What they can now do, they can analyze the information, and they'll do it in an automated code, because all they have is a little tiny job title, there's no task description, that's the only information they have. They can automate the coding. They can create risk groups associated with occupations, or they can put income categories onto that. They can begin to categorize your risk in a much more precise manner.

They'll be wrong, but, of course, when their systems throw out cases and say, don't insure this person, somebody will look at it and see that it's wrong and code it correctly. That's the sort of situation in which we see computer-automated systems working.

For census applications, for surveys and so on, it's computer-assisted coding.

SAL CORRALLO: Earlier, in response to a question of linking education, formal education with work experiences, several of the respondents indicated the difficulty.

I noted, in part one of your publication, references to skills and references to grade levels. Would you comment on that, and why that's in there, and some of the issues around that?

PETER ELIAS: It's in there because it's an explanation of the concepts underlying the construction of ISCO–88, and, of course, ISCO–88 and its Community variant.

Skill level in ISCO is operationalized in terms of the number of years of formal schooling and/or the number of years of relevant work experience. It's not just formal schooling that's used, relevant work experience, and vocational training, on-the-job training can substitute for those years of formal education.

One of the hardest tasks that we have in different countries is trying to reach agreement upon what is a particular skill level, as operationalized in these four skill levels that we have within ISCO–88, and drawing the relationship between these is very difficult, indeed.

It leads into conversations about where should primary education teachers be allocated in different countries, and some countries of the Community are allocating their primary teachers to major group three of ISCO, associate professional occupations. Others are assigning them to major group two. It's on the basis of the formal educational requirements to become a primary teacher. In some countries, you need to have the equivalent of a

first degree to get the educational qualification that allows you into the teaching profession, and that's as true for primary as it is for secondary education.

In other countries, there are different standards established for primary, as opposed to secondary, and this is a fluid situation. This means that those teachers will be classified in different parts of the classification in different countries within the Community, but that's right, that's what we are trying to compare, skill levels between countries.

But, operationalizing these is very difficult indeed. In the U.K., maybe our next revision of the Standard Occupational Classification for the United Kingdom will take advantage of the development of our system of national vocational qualification, where every job is being examined in terms of what sort of vocational preparation is needed within that job, how is it provided, how is it obtained, how long will it take, and, of course, there must be some relationship between that information and the skill level concept used to operationalize the classification. But we haven't done it yet in the United Kingdom, and I know of few countries where there is this very direct relationship.

OLIVIER BERTRAND: Peter has mentioned three types of difficulties in adapting ISCO, and I am faced with a fourth one. I would like very much to know his advice on that, that is, it's hard for me to understand the rationale behind the division of manufacturing workers between two major groups, one being called, I believe, craftsmen and related workers, and the other is workers working with machines and assembling workers.

And, I think for one thing, it doesn't correspond to the modern organization of manufacturing, and it's not clear whether it has any relationship with the skill level, because the reference to the skill level is the same.

So, when you think, for instance, about the operators on machine tools, the setters and setter operators are in one major group, and the other are in a different major group, and I think this division is completely artificial and raises very difficult problems.

PETER ELIAS: Olivier has raised a very difficult question for me to answer. Some countries have no difficulty at all in telling you which occupations are craft-type occupations and which occupations are operative-type occupations, and I suspect it's in those countries where there is a tradition of a kind of Anglo-Saxon styled usage of the word craft. These are very old words that we use here, versus the more modern use of the word operative, that we have some idea what these distinctions are.

In other countries, this is not so easy at all. And, here, we must rely upon the definition within ISCO–88, that distinguishes between craft on the one hand and operative on the other. It goes something like this. It says that craft workers have more knowledge—they are both at the same skill level, so that doesn't help us—but the craft workers have got more knowledge about the nature of the production process, in terms of the overall system, the relationship between the tools that are being used, the materials that are being worked on, a knowledge of different techniques and some control over the whole process of creating articles.

Operatives, on the other hand, are in a more programmed environment, in which there is a set of instructions that they must follow, usually quite strictly to be followed, and while they might be encouraged to take their own initiative to report faults in machines, to maintain quality standards and so on, and while they might be empowered in various ways to follow through and to take remedial actions in certain situations, everything is done by the book.

That's the ISCO theory. The practice is, of course, much, much more difficult, as we now move away from the traditional craft occupations, so that, essentially, more and more occupations are put into the realm of this programmed set of instructions where workers are given a high degree of flexibility in terms of the operation of those instructions and the interpretation of those instructions, but there is a relationship between the instruction, the action that has to be taken, and the outcome.

I think this is going to be a problem for the future, and I think you've really put your finger on something there.

JACK TRIPLETT: Well, actually, I have two questions, one about tip number three and one about tip number four.

On tip number three, you (Peter Elias) remarked that one should establish criteria, publish them, and then ignore them. And that, I think, was consistent with the remark that Seymour Wolfbein made the first day of this conference when he said, "There were 12 principles in the SOC, all of which were violated."

The question, I suppose, is, why is that an actual condition, or, let alone, why is it desirable? I could think of possibly one reason. Perhaps, our common sense and pragmatic rulemaking in making the decision about classifications exceeds our ability to generalize, and so it's the generalizations that are at fault, and they are essentially wrong. You have a rule in there that you shouldn't pay attention to controlling other people, and, yet, you want information on managers. Obviously, it's a wrong rule.

So, one answer, I suppose, might be that the rules that people cook up, or have cooked up in the past, aren't appropriate rules, which isn't the same thing as saying they wouldn't be appropriate in the future.

So, my question is—I'm not quite sure what you meant—is it the feeling that we can't formulate acceptable criteria that are really useful, or is there something else that was involved there?

PETER ELIAS: Well, of course, it was tongue in cheek, but there was an element of truth to that, that no matter how we formulate the concepts underlying the construction of the classification, we will have the exceptions to those rules. And the question then becomes, well, how many exceptions will we allow before we begin to say, well, there really is no rule here? That's the problem that we have.

Can I give a concrete example of where I think this will become a very acute problem in the U.S. case?

If you look at ISCO–88, you are going to say that as far as the U.S. Standard Occupational Classification is concerned, it will have some comparability with ISCO–88, or it will take note of ISCO–88. You've got to say that, because, of course, the United States was there at the 14th International Congress of Labor Statisticians, and signed up for ISCO–88. So, you've closed off your options in that area.

But, if you look at ISCO–88, there were no supervisors anywhere in ISCO–88. Are you going to say that the U.S. Standard Occupational Classification will have no supervisors, because once you put the supervisors into the U.S. classification you are going to break the comparability with ISCO–88—unless you do it at the very lowest level of the classification, which is automatically going to double in many parts of the classification the number of building blocks that you have within the classification. Or, are you going to take the international recommendation and treat supervisors as status in employment?

I would imagine there will be a public outcry if you drop supervisors from the standard occupational classification. So, you have a dilemma there. The dilemma is, if you are going to publish these rules about skill levels and skill specialization, and state that they are equivalent to the International Standard Classification of Occupations, do you then break the rule to satisfy the needs of the users?

Well, I don't know the answer to that, but that's going to be a big problem for you.

JACK TRIPLETT: The other response to my own question is, that a lot more resources need to be put into developing the concepts and making sure that the concepts, in fact, are appropriate for the use of the data. That's another way to go on this. But, I don't want to argue that.

Point four, actually gets into the same kind of topic, because there you recommended that there be a committee of producers who meet with users, and I certainly concur with that. But I wanted to ask you about the point that Richard Madden made, that in this audience we seem to have two quite diverse sets of users—one set of users who are interested in statistical analysis and labor market analysis, and another set of users who are interested in data that can be used for program administration—and I wanted to ask you whether that was also true of the process of adopting a classification system in Europe. Did you have that same two divisions of user interests?

PETER ELIAS: No, is the simple answer. We've approached this essentially from the statistical viewpoint, the statistical perspective. We are trying to make comparable statistics.

We are now turning our attention to the European Employment Service, which is exchanging information about jobs, and saying to them, are you talking this same language of the ISCO–88(COM), which is the statistical language within the Community, and we are busy trying to pull those two sides together.

Now, maybe that should have been done at a much earlier stage, maybe it's too late to do that. But it's a very big problem, and when you are working in nine languages with 12 countries, it's horrendous.

But, I really wonder whether you have two communities of users here. I mean, obviously, there are people who want the detail for program implementation, and they must have that detail, but they are going to be asked questions by clients saying, what is this occupation, what is that? How do we define this? They are going to want to seek those answers using DOT.

But, unless those people involved in program implementation can look at, interpret, and read statistics which are relevant to the detailed categories that they are looking at, they are not going to have the overview, the ability to put into a context the information that they are giving. And I think that's extremely important, that people are not seen as either/or in this, but that we are all users of the statistical information which informs us about employment trends, economic trends, and guides us in this important decision making about occupational choice, or about the direction of labor resources, or about the development of macroeconomic and microeconomic policies to influence the labor market.

These are all based upon statistical information, and that's why I stress that as being of fundamental importance, but, of course, there must be the very strong link with those who need the detailed information at the program level.

JAMES SCOVILLE: I would like to caution, because it might well happen, that we want to be aware of what one might lose in any easy equation of skill with level of education.

The cause may well be because of our own deficient school's link to work in this country, but from an industrial relations point of view, or the sociology of work, it will not do to say that a person, an autonomous worker working on tools and machines with a high level of responsibility, perhaps, has the same skill as a person tending a machine because they have the same education.

In this country at least, that is not true in terms of how a person gets to that job, how the person is prepared for that job, the person's rights and probable tenure on that job. So, you may want to do this, but it is not going to make some of us who study industrial relations particularly happy. It may still happen, our happiness is not in your objective function.

JOEL POPKIN: Since I was sweeping in my endorsement of the Canadian system and in attributing it as my source of inspiration, perhaps, I was over-sweeping, in fact, because I think I've learned a lot from the papers presented by the participants from other countries that I had not been aware of at the time that I was writing this paper.

But, with that as background, since I feel I can be a little critical of the Canadian classification system, I was not as specific as you have been in defining the words that go on the skill-type columns. I was thinking in one context about an information economy versus an in-person services economy. I was thinking about some kinds of policy uses that are out there for information at that level of the hierarchy.

The way I'd put my concern, really, is, what is the interesting question; to which the answer is, there are 2 million people who work in business, finance, and administrative occupations? I think there's more interest and questions about what kinds of skill types suffer because of the openness of an economy, what kinds of skill types might experience increasing wages, perhaps, because they work with more capital. But to a certain extent the column heads in this may be akin to what Secretary Reich described as the way we describe ourselves.

MARGARET ROBERTS: First, let me say that the skill types, as described here, was a very bottom-up exercise, as I described earlier. We went out and we found unit groups, we described and organized the world of work into units, and we built it up on what seemed to be the most dominant aspect of each group.

In the case of business, finance, and administrative occupations, from a skill type dimension, that seemed to be the most important thing. In terms of science, health, et cetera, it seemed like knowledge of a subject matter was the dominant force within it.

We did not imagine that the skill type columns would be the major groups. That is not a statistical level of aggregation. It was the organizing principle that we decided to use in the book itself.

In the first draft of the classification, we organized it differently. We organized it according to management, then professional occupations, technical occupations, then clerical, and, I imagine, that's what you looked at before.

As a result of user feedback, we decided for the final draft to reorganize. And users, especially users in the career counseling, education communities, asked us to stay away from over-emphasis on professionals and technical occupations, because they wanted to organize libraries, and things of that nature, according to subject matter.

From our point of view, it made very little difference. Our statistics, our major groups are the groups such as professional occupations in business and finance, and professional occupations in science and natural applied science. If someone prefers, for analytical purposes, to look at this classification from the point of view of management, professional—professional in any particular area, or technical, then it's all there for them to use.

So, it wasn't really that we particularly favored the skill type categories, it seemed to be the most accessible to the user community as a principle of overall organization of a book and a numbering system. I wouldn't want to over-emphasize their importance, except in that there are certain commonalities about the way these columns work that can be useful.

PETER ELIAS: I question some points for Barbara. There's a point in your paper that you make about ISCO, where you say that skill levels are assigned at the major group level. That's not correct. The skill levels are assigned within the unit groups, the lowest levels of ISCO, and they are aggregated using the principle of skill level.

One of the main points that you make in your paper, is that you say it would not be advisable for the U.S. to follow ISCO closely as a model for revising the SOC. Well, I would endorse that. I don't think a country which is of the size and important as a world economic power should take an off-the-shelf classification which is designed primarily for international exchange of occupational information. That would be inappropriate.

But, I think you said it yourself, within the framework of ISCO, if we are using this as an organizing set of principles for the development of an SOC, then it follows that the new U.S. SOC should be in a way comparable with ISCO. Now, that's very important, because if the U.S. is going to make comparisons with other countries, then it's got to be done using the currency of ISCO–88, and there's got to be a way in which that can be reflected in terms of making another cross-walk from the U.S. SOC into ISCO–88, and that should be possible if you use the concepts of skill level and skill type or skill specialization in the construct of the SOC.

You mentioned, though, reasons why ISCO seems inappropriate, and you talked about differences in terminology. Well, this is true the world over. There are differences in terminology. They, perhaps, look worse because they appear to be English, but they are not English. We have the same problem with ISCO in the United Kingdom. I'm sure that the Canadians reading ISCO would scratch their heads and puzzle over some of the words in there, and across the European Community we've had the same problems.

My answer is when you make the crosswalk from the new U.S. SOC into ISCO, let's have a look and see if we can help you at that stage to negotiate your way around some of these differences in terminology.

You talked about heterogeneity in skill levels. That worries me a little bit, because that seems to suggest that you want to see more than four skill levels in a new U.S. SOC. The more you go for, the more difficult it will be to operationalize the classification in a coding context. Now, this is a point that was made very appropriately and very forcefully by Statistics Canada, saying that the classification depends, to a large extent, upon the nature of the information that you have to classify. You can't divorce one from the other. You have to recognize that information when you are building the classification, and you have to trial the classification upon all these different sources of information and see what the problems are going to be.

I think you'll find at that stage, that if you go for a larger number of skill levels, and we've seen in most of the other national classifications which have operationalized skill, if you go past four or five, you are going to have problems because you just haven't got the information in the basic data that you are trying to classify.

BARBARA WOOTTON: Your points are all well taken. I think the one area that worries me the most about the ISCO skill levels—where I think there might need to be a breakout— is the category that Jim Scoville talked about. That is, among workers in our country who are not college educated, there is quite a differentiation in the skill level. As Jim pointed out, there are large differences in skill requirements for somebody who is programming CNC (Computer Numerical Control) equipment and somebody else who is just watching a machine and counting widgets going by. It's particularly that level where we have very little information in this country and where it's most important for us, I think, to be trying to develop or draw out distinctions.

JACK TRIPLETT: I think that the information on skills, the information on what it is that workers bring to the job that is, indeed, productive, that's what I mean by skill, the information on skills is vital for just all kinds of things.

But, I'm a little troubled at looking at the matrix, I mean, that's the thing I pick on, I'm a little troubled about the notion of skill level, and what troubles me a bit is that, it's what I think has been said here before, it's that we, as professionals and intellects, may look at this and say this is reasonable and, yet, is it not some of our own values that we put in the skills? I'm troubled, for example, in this country, the notion that legislatures, and legislators, and managers in public administration would be at the head of any ladder would be, to say the least, controversial.

And then, I notice that in the arts, my daughter, the poet, would certainly agree that the skill levels of creative writers and librarians are higher than the skill levels involved in athletics, and, yet, I wonder if that is a judgment that large numbers of our population would agree with.

You see, my point is that, in forming skill levels, we've used explicitly education, and we've used some other judgments, I'm not sure that we've got information to do a matrix of the type that you have here, where we've really got productive skills to make this matrix. Clearly, that's what we want, and we've got—I don't want to be too critical, because basically you are really working with the information we've got. My point, I guess, is that, what we have are some rough proxies for what skills really are. The rough proxies have something to do with education, experience, et cetera.

I always want to point out the fact that we just need really a lot more about what it is that humans have that's really productive.

MARGARET ROBERTS: I just want to make a comment. First of all, in terms of management, and legislatures, you'll notice that I did say it was a skill type, it may be at the top but it is not assigned a skill level overall. For that very reason, we, in our draft, did put it in skill level A, as part of skill level A, and we stepped back from that, in that we felt a lot of the managers in a lot of the groups were not equivalent to professionals, and that's why they aren't given a skill level in this scheme.

As far as the arts goal, I certainly admit this was a lot of judgment calls. Unfortunately, as you say, we don't have the information, we don't even have the means to have the information. Nobody really knows in any kind of absolute terms, how you could relate artistic talent to scientists or something. Nobody really knows, so we took a rough crack at it, and I certainly admit that that's what it is, especially in terms of the arts, in terms of athletes.

In terms of the professionals, I think it does reflect at least current practices and demands of the system.

Where Do We Go From Here?

Introduction

This final section provides the closing remarks of Katherine Wallman, Daniel Weinberg, Raymond Uhalde, and Thomas Plewes. These representatives from the Office of Management and Budget, the Bureau of the Census, the Employment and Training Administration, and the Bureau of Labor Statistics, respectively, summarize the lessons from the conference and plot the direction that these major players must move in, together, to revise the SOC to meet the occupational information needs of the twenty-first century.

Katherine Wallman

Office of Management and Budget

As I lead off this last panel which has been charged to provide a bit of a wrapup on the spot on what we've been hearing during the last 3 days, I feel somewhat personally challenged.

It's been a bit awkward sitting right in front of the speakers for this entire conference, particularly as references have been made to the view that "OMB is going to solve this problem." I'm challenged the same way I was when I gave a talk at the Population Association meetings about a month ago at 7:00 a.m.; the few people in this room who know me know that 7:00 a.m. is definitely not my time of day. It got worse as I walked in the room and there were 100 or 150 people, and each one who came up to me said, "The only reason I'm here is because you are here." So, one feels one should do one's best under those circumstances.

I am not going to try to present a synopsis of what I've heard. I would like to provide a little bit of context for why OMB is involved in this business at all, for those who may not be so familiar with the role of the Office of Management and Budget, and try to provide a little bit of a bridge to my co-panelists, who will give some perspectives from the agencies of what they've been hearing the last couple of days.

I am often asked, sometimes seriously and sometimes somewhat facetiously, what it is that the Chief Statistician at the United States Office of Management and Budget does? If I were to answer that question for you in a somewhat formal way, I would say that we have three principal functions. We try to facilitate coordination in our decentralized system—and those not familiar with the system here have had a good look at it over these last couple of days. We try to foster long-term improvements in the system, and we have responsibility to develop and monitor the implementation of standards. The latter is exactly what we've been talking about here today and the 2 days before.

It's under this last guise that I have been spending these last few days with you, or at least I would say I've tried to spend the last couple of days with you. Were you to look at my calendar, you would find that it says I have been here all the time the last 3 days.

I'm certain that a number of you have noticed my comings and goings, and it became particularly obvious from my "front row" seat. I hope you will accept my apologies for that, but what has happened the past 2 days does serve in a way to illustrate just what it is the Chief Statistician has to do. Let me give you two examples of why I was jumping up and down.

One involves, in fact, the issuance of a standard—not the one we are discussing here today, but rather the final decisions related to the next release of the Metropolitan Area Standards, which will take place next week. There have been a few controversies about what was issued in our last *Metropolitan Area Bulletin* in December, and we have been attending to those. On Tuesday, we met with the Director of the Office of Management and Budget to review the final decisions.

Just when I thought I could then sit down and enjoy the rest of the conference, we began to get feedback from the congressional committees in the House of Representatives on their marks for appropriations for the statistical agencies for Fiscal Year 1994, and we had something on the order of 4 hours to get our comments into the process so that those responses could go back to Congress before the full committee sessions were held this morning. So, that is my excuse for where I have been, why I have been jumping up and down. I hope you will understand.

As some of you know, I have spent the past 11 years outside of government, essentially as an advocate for the quality and accessibility of the statistics that are produced by our Federal system.

At times, I was critical of the OMB Statistical Policy staff. In particular, I couldn't understand why they never got around to doing some of these things they were supposed to do, like developing and revising standards, and I must say I also got annoyed with them when they popped in and out of meetings.

My tolerance on both of those scores has improved a great deal over the last 4 or 5 months since my return to OMB. One of the things that I have come to realize is that in addition to the more formal functions that we perform that I set out at the outset of my remarks, we actually serve as well as "statistical consultants" for the Executive Office of the President. What does that involve? An example may serve best to illustrate. Every day we receive one or more pieces of legislation that is going through the Executive Branch review process, that has some statistical aspect to it. Members of our staff are asked to comment on, and give guidance on, whether these are a good piece of legislation or a good provision that are in pieces of various legislation.

Let me try now to bridge back to the subject at hand, by noting once again my role as an advocate for users of the products that are produced by the Federal statistical system, users who in my view include Federal agencies, State and local governments, academics and other re-

searchers, the business community, public interest groups, and most important to me personally, the citizens of our country who I think are the ultimate users of the information we are all producing here.

As I return to OMB, I must say that I carry this bias with me, and I plan to do my best to maintain this bias.

The views that we've been hearing over the past 3 days represent, in the truest sense, the views of various components of the user community broadly defined. Although we at the Office of Management and Budget are prone to say that our standards are for statistical purposes, and in a formal sense that is true, the fact is that our standards have as well a great number of other lives that extend well beyond what might be called "statistical purposes." Many of the concerns that have been expressed in this meeting have come from those constituencies that are responsible for the uses of these standards that have been embraced in legislation, in regulations, in program administration, in evaluation, in research, and probably in a number of other ways that I have failed to name in this brief summary.

In a very real sense, these standards affect the lives of our Nation's citizens. So, while I might, under a strict interpretation of the authority of our office, echo Richard Madden's statement this morning that our standard occupational classification is "simply a statistical classification"—I think those were your words, Richard—I believe it is incumbent on us, who develop and promulgate these standards, to ensure that our work addresses the realities of the way those standards are used, and how they are used in ways that extend far beyond what we would normally consider strictly statistical purposes.

I have one additional bias to share with you before I turn the session over to our panelists, who will discuss "where do we go from here"—and I do hope they will tell me—and that bias is that I have what I refer to sometimes as a "can do" attitude. I am less interested in hearing all the reasons why we cannot do something, for example, because our legislation says so, which I hear a lot, than I am in hearing how we can do something. How can we work together toward a solution that will, perhaps, not be easy, and that, perhaps, will not please all of the people all of the time, but that will represent the best approach to meeting valid needs and concerns that have been expressed here?

If I might paraphrase the challenges that Tom Plewes presented at the outset of the discussions on Tuesday, we have been challenged over the last 3 days to hear the views of users, to consider the U.S. system in a global environment, and to consider our occupational classification system in light of other systems.

Perhaps, a first glimpse at how well we will have met these challenges will be provided in the thoughts that our panelists will share in this session that will close the conference, and that will result in the beginning of our work on revising the standard occupational classification system for the United States.

With that, I'm going to turn to my panelists, Dan Weinberg from the Bureau of the Census will speak first, Ray Uhalde, from the Employment and Training Administration, and finally Tom Plewes from BLS will speak as the third panelist.

I think that I have you here overtime at this point, according to the published agenda, and you are really good about staying on. I don't know if anybody wants to raise a question or not of this particular panel.

My office, and I in particular, often get asked how it is we manage to take on and fulfill our responsibilities with a professional staff of five people. The simple answer to that question is, we can't. There is a slightly more complex answer, and I think that you have witnessed that answer in the conference you've been involved with here the last 3 days.

Much of what we are able to accomplish results from the very dedicated and talented staff activities that take place in the various statistical agencies that comprise our decentralized Federal statistical system.

In this instance, the Bureau of Labor Statistics, with help from other agencies at the Department of Labor, has borne the major substantive and administrative responsibility for the conference that we have had here on occupational classification.

We are indebted as well to all of you who have shared with us, both in your papers, and in your comments during these sessions, your thoughts about what we should be doing, and your experiences in trying to do things yourselves.

I think over the longer term the best way that we'll be able to demonstrate our thanks to all of you for being involved in this conference will be by showing that we can, in fact, learn from our colleagues in other countries, and by showing that we can listen to our users here at home.

Last week in Geneva, Canada's Chief Statistician, Ivan Fellegi, recalled a statement some years ago by one of the world's leaders who offered at a particular juncture, that we had reached what he called "the end of the beginning." I think that's where we are right now. We are at the end of the beginning of our process to revise with your help the standard occupational classification system for the U.S., and I thank you all for joining us in that.

Daniel H. Weinberg

U.S. Bureau of the Census

In November 1991, the U.S. Bureau of the Census convened another international conference, on the classification of economic activities, which focused on plans for revision of the Standard Industrial Classification (SIC) system (U.S. Bureau of the Census, 1992). The Census Bureau invited Ron Kutscher of the Bureau of Labor Statistics to open their final session, "What Next?", so I suppose it's fitting for the tables to be turned. I want to express a debt of thanks to Ron, and to the other participants in that conference, because some of what I will say about the Standard Occupational Classification (SOC) is similar to what they said about the SIC. These remarks are part summary, part critique, and part my own opinion. As the executive summary of the SIC conference volume pointed out, the U.S. economy is characterized by rapid technological change and increased globalization. Those factors have just as much to do with affecting the SOC as they do with the SIC. Indeed they speak, as some speakers already have, about the need for greater integration between the SOC and the SIC. They also suggest the need for a dynamic system able to adjust quickly to changes in the economy and for increased international comparability. I think those needs are incontrovertible. Let's not wait 17 years between revisions of the SOC; why not think about changing it every day? As the commercial says, let's just do it! Let me pick up on some other themes of both conferences.

First is whether the SOC needs a conceptual framework, and whether the SOC and the *Dictionary of Occupational Titles* (DOT) need a common framework, based either on economic theory or some other scheme. Regardless of whether these two systems share a common framework, the relationship between the SOC and the DOT needs to be clear, and continually maintained. The same is true for the relationship between the SOC and the current surveys coding— particularly the Current Population Survey (CPS), a household survey, and the Occupational Employment Survey (OES), an employer survey.

The key to successful relationship is that the SOC must become the basis for all collection, analysis, and publication of statistics on occupations. (I trust this is not a surprising statement from a statistician associated with the Bureau of the Census.) In effect, the CPS and the OES would be held to the same coding, though of course each could report more detail (if reliable) as long as it could be aggregated to the SOC common reporting level. Having these common building blocks will facilitate other uses.

How would this relate to the DOT? Each SOC basic reporting level could be comprised of one or more DOT job titles, in effect mirroring the United Kingdom system described earlier—a Volume 1, consisting of the basic statistical structure (in their case 371 occupations); a Volume 2 consisting of a dictionary of titles (for the U.K., 23,000 job titles); and a Volume 3 consisting of a crosswalk to previous coding schemes. I agree with Mr. Madden of Australia that it is difficult to conceive of the DOT as the basis of an SOC (that is, bottom up); the DOT is closer to M. Bertrand's notion of the world of work as a continuum of activities, perhaps too close for it to be the basis for a statistical standard.

What about the new "database" of Occupational Titles we have heard described as the vision of the Advisory Panel on the Dictionary of Occupational Titles? That vision is skill-based. The only way to integrate a skill-based DOT into the SOC is for the SOC to be skill-based as well. That's the underlying theme of this conference, but let me come back to that point a bit later with a bit of cold water.

I must add that I am skeptical about a goal of making industry an integral part of the SOC, as we have heard other speakers suggest. We have the SIC for that! If we want industry detail, then cross-tabulate occupation by industry. A bookkeeper is a bookkeeper whether working for a construction company, IBM, or Disney World.

Reasonable international comparability should be a goal of the revised SOC, not just because we signed up as part of the international conference back in the late 1980's. I think a careful look at ISCO–88 (COM), as it is being implemented by the European Community, should be a part of the revision process. Unfortunately, while statisticians are easy to persuade that the U.S. needs a good reason to be different, I am afraid that politicians in the U.S. often need a good reason to be the same. Nevertheless, I was very impressed by the "top down" Dutch approach, though it raises the important issue of historical continuity. Some users rely heavily on time-series comparisons. Let's not forget them.

To be sure, some of these various goals are in conflict. How can you increase global comparability and move toward a dynamic system without decreasing historical comparability? You can't, and some tradeoff will have to be made. How can you create a dynamic system in a world of limited resources without compromising quality? It's difficult to say the least. With a dynamic SOC, how does one distinguish between substantive and interpretive changes? Does one need a theoretical basis or

should we focus on actual use? Should the theoretical basis be supply-side or demand-side? What is the role of statistical reliability versus common sense? The trade-offs multiply.

Let me return to this conference's focus on skills for a moment. The Canadian system, for example, is skill level-based. Fine in theory, but skill level is often measured by education level. As we discussed earlier, there is substantially more variation in actual skill level in the United States among persons of a given educational attainment than in most other countries. What could we use in place of education in the U.S., and, if we used an alternative, how do we ensure international comparability?

Perhaps we could develop some objective measure of skill that an employer could use to classify a job. Fine for the OES, but not so fine for household surveys. What kinds of additional questions would need to be devised to accurately determine the skill level of a particular employed respondent?, not to mention finding the time and dollar budgets to ask those questions (especially on the Decennial Census where time constraints are severe) or the issues of accuracy and timeliness. This is a basic problem in revising the SOC to conform with international standards and in integrating the SOC with the DOT. Skill level appears to be a demand-side measure; household surveys ask the household—the supply side—the questions. Even if we figured out how to ask, the answers may not match.

Two other more minor points. First, what about jobs that cover more than one occupation? How do we classify them? Second, how do you implement a dynamic system of occupations in a world of rapid technological change when not all enterprises adopt the new technology at once?

One of the earlier speakers said that all 12 of the principles behind the 1980 SOC were violated during its construction. Our first task must be to agree on the rules, but, as Jack Triplett said, they need to be based on common sense. We obviously need to set up some interagency task force as has been done for the SIC, but we also need to have an extensive user outreach program. The users of occupation statistics have a broader range of needs than the users of industrial statistics; those looking at labor market discrimination have very different needs from career counselors.

A final point. Based on Peter Elias' remarks about the relationship between the resources available and the results produced I am very encouraged. I am sure the U.S. will have a truly great revised SOC because we have only very limited resources to put into its development. Let's get going, 1997 is not far away!

Reference

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Raymond Uhalde

Employment and Training Administration

Good afternoon. It is late, and I will try and be brief. First of all, on behalf of Carolyn Golding, who was scheduled to speak at this point in the conference, and was not able to attend, and on behalf of the Employment and Training Administration, I'd like to thank all of you for the ideas, time, and energy that you have put into this conference. We value those contributions. Even though I am sitting at this table flanked on both sides by statisticians, I don't pretend to be a statistician. But I think it is appropriate that a representative of my agency be here, because ETA has a technical component to the work that it does, and we are also a major user of information that we are talking about at this conference.

We manage the process of collecting information for the *Dictionary of Occupational Titles*. But we are also a major user of that information in our education, training, and job placement programs through the provision of labor market information to clients out in the field. So I come here viewing the subject with two hats.

I understand that the Secretary's remarks, and mine, in part, are intended to convey that ETA is here to affirm its commitment to working with BLS, NOICC, and certainly with our brothers and sisters at the Office of Management and Budget (OMB), within our limited resources, to try and build a unified occupational classification structure. We are committed to that. I say that because as the Secretary of Labor mentioned earlier today, we are in the midst of trying to develop major systems in this country with regard to the transition of young people from school to work, and the transition of experienced workers from one job, one occupation, one industry to another. We want to foster and promote that transition, and do a better job of helping people. While I'm not a statistician, I *am* an economist and I know you can accomplish these objectives more efficiently if you have good solid information. A way to help ensure this is to develop a single, unified, occupational classification system.

We need to do this because, while we've run training programs in this country for 25 years, and public education programs for many more years, we find it increasingly difficult to effectively prepare people for the workforce when we don't know what the precise demand for skills is.

So, in recent years, we have begun to identify the skills required by a changing work place, and by employers. This is an ongoing process and is tied in with our commitment to build a skill-based classification system.

There was some discussion of the Advisory Committee for the Dictionary of Occupational Titles this morning, and some of their recommendations. We are prepared to move forward on them. We see great importance in this. In fact, ETA has decided to begin using the Occupational Employment Statistics system in reporting training and placement efforts in our Job Training Partnership Act programs.

We've had discussions already, and we are prepared to work with BLS, probably on a nonfinancial basis (Right, Tom?) and work very closely. We may even sign a piece of paper committing to this nonfinancial arrangement between the Bureau and us. We want to work toward creating a single classification system which we think would be skill-based.

I acknowledge Dan's concerns particularly about certain problems related to collecting data using the household survey. But as a user, we have a "can do" attitude. We think somebody can resolve those issues and we ought to go about the business of doing it.

The Secretary asked for a step-by-step process, an analysis of what needs to get done to realize a single system. I think together we should sit down and figure out what that work plan is and what strategy we need to accomplish it. We should lay this before the Secretary, before OMB, and before the larger community that is here, to demonstrate that we mean business. We certainly welcome any others into this community to help in this process.

I would say, in closing, that one of ETA's major emphases is providing information through a system of "one-stop centers" which we hope to establish. We see "one-stop centers" as essential if we are serious about promoting lifelong learning in this country.

We ask adults, once they leave school, to participate in skills upgrading, knowledge acquisition, and education, and then we hide the essential information that people need in order to make decisions about lifelong learning. We make it inordinately difficult for people to get the assistance they need. The information may be at your local college. If you happen to be a 40-year-old adult who hasn't been back to school since high school graduation at age 18, we say, well, if you really want to continue your education, you have to go into a school setting just to obtain information about programs available. That is not—certainly not—a user friendly system. It's not even a system designed to provoke the kind of behavioral change we are looking for in this country.

In this connection, a major recommendation from the APDOT was to make the *Dictionary of Occupational Titles* more accessible and more user-friendly. Something like a system of "one-stop centers" would also promote a more user-friendly atmosphere, and make information accessible to individuals of any stripe, at any point, regardless of where they are in their life cycle, whether they are employed, unemployed, or on welfare, whether they are students or mid-career workers looking for information in order to make career changes or upgrade their skills. We ought to make it easy for them to get that information, and it ought to be quality information, not only about career and skill requirements, but also about vendors and alternative providers of training and education. We need to provide consumer information about who provides such training, the quality of such training, and the experiences of people who took part in such training, so that individuals can make informed choices.

Again, we at ETA have interests on both sides of the equation—producing good information and making it accessible to our customers. Thus, the results of this conference are very important to us.

Thank you very much.

Thomas Plewes

Bureau of Labor Statistics

The last day, the last session, the last speaker, 5 minutes to go, if I stick to the agenda.

I don't want you to think that I wrote the solution here before I came in, but I do have some overheads that we generated this noon. I want to share a couple with you.

I have some awards to give in the course of this conference, because I've really seen some promising solutions come along, some of which were generated by the audience, and some of which were generated in my feeble mind.

The first promising solution is to Neal Rosenthal's vexing problem of all the tile layers, the hard and soft, and the carpet layers. The solution is shown. Okay. We've got to get rid of those job classifications, it's just too vexing. There is no answer to the tile layer's problem, so that's what we'll do, we'll just require people to lay concrete floors and we'll get rid of that particular problem. Neal, will that solve your problem? I hope so.

We had another opportunity to solve a problem, and I think we did. Jack Triplett, in his earlier comments, talked about his favorite discussion in terms of the standard industrial classification, that sugar is kind of a world famous story now, and, you know, what goes on with sugar. Well, we generated our own here in this conference, and I think that combining those two brings together the idea that Seymour Wolfbein was bringing to us, that you've got to look at occupations in terms of industry. So here's my solution to that, the sugar coated airline pilot. All right. Those poor airline pilots who are classified as technicians, oh, my goodness, well, we'll sugar coat them and everything will be all right. Well, I thought that was kind of an innovative kind of solution to a particular problem, and I hope that will start a new vocabulary there.

I think we had a pretty good example here in Fred Conrad's discussion of what came out of our kind of laboratory work about intuitive ways of looking at things, but, unfortunately, this group was not convinced, in terms of, well, if it was intuitive, it's got to be right.

However, I think that we did agree on one thing, and, that is, you should avoid counter-intuitive classifications. So, Fred, we thank you very much for that comment.

And, finally, as carrying forward the whole theme of everything we talked about here, and to take off on a U.S. presidential campaign saying, "Skill, stupid." I mean, isn't that it? That's where we come to here. This is what we have, indeed, come together and agreed upon, if you will.

In this last session of the conference I want to carry on one more kind of a thought process with you. I think we can learn a lot about the excuses for not having done the right thing in the past—the right thing in the past was to have had all of us accept the standard occupational classification, use the standard occupational classification as given to us, integrate the DOT with the SOC, and make it all work together. In other words, we should have done all these things we are talking about now.

But, I heard some really good excuses at this conference for not using the SOC. I want to share them with you. Some are good and some are really fabricated.

Here's why we don't use the SOC. *It's too old.* All right. How old is it? It's 12 years old. How much goes on in the course of 12 years, really?

When we looked at the OES—we were trying to cut the OES a few years ago—we said, well, why don't we just ask questions in industries in which occupations change quite frequently. We weren't able to find any industries in which occupations changed quite frequently. Occupations change, but they change, if you will, glacially, not in such turnover terms.

And, we talk a lot about those industries in which change seems to be extraordinarily rapid. Many refer to Hyundai, Marysville—three occupations on the floor versus the old GM plants with 80 occupations on the floor. We hear those stories, but when we look at the data we find out, indeed, that those industries are very few, that most organizations do conduct business in the same old way. There are the high-performance industries that we have to have a system to support. Too old, well, that's something that we just have to think about. I'm not quite sure the SOC is so old that we have to get rid of it.

No conceptual foundation. Probably a pretty valid criticism. It's not either demand side or supply side, today it's a mixture of both, although it's tilted toward a demand side concept. In reality, as it has evolved now, the OES and Census systems define what's meant by the SOC.

Criteria don't apply. We've worked that one to death. We had a good explanation of what the criteria were, and found out, indeed, that most don't apply universally. Quite frankly, most of us agree that the criteria shouldn't apply universally, because the criteria are not the kind

of criteria that we need for a system that's going to carry us in the next decade. The reason we don't use the criteria is because they don't apply. They are not useful; they've got to be revisited.

Reporting problems. We heard a lot of good explanation about reporting problems. The fact of the matter is that we don't use the SOC because it's impossible to carry forward with the collection of information that fit into those kind of boxes. People just don't think that way, companies don't think that way, and people don't think that way when you ask them in our surveys.

It's arbitrary. In fact, it's arbitrary on purpose. We heard the Census Bureau talk about some of the decisions that they made which were very arbitrary. They were good decisions because they arbitrarily reflected what really goes on in people's minds, in the way in which companies organize themselves, and in the way in which things happen.

Lack of customer requirements. Let me spend a moment on the issue of customer requirements before we all jump onto the band wagon that says that we have to use the OES for the substitute for the SOC. There has been a lot of good thought going into the selection of occupations within the industries to add to the OES, and we have a process now going that's going to keep it modern. The fact of the matter is that customer requirements largely drove the selection of those occupations which were added to the OES and that now differentiate the OES from the SOC. Many of those occupations were added at the request of the National Science Foundation, which paid BLS to collect information on technical occupations.

Now, that's okay, because they are the customer. But, if the customer were a National Sales Foundation, would the OES be carrying more sales occupations in the OES? The answer is probably, yes.

Before we accept the OES as a substitute for the kind of SOC we want to move toward, we need to think about why we have made some of the decisions as to some of the occupations we have added.

I submit that the OES structure is not the ideal system that we want to move toward. I support the decision of the ETA to say it's probably better than what we have right now in the SOC, because it is more reflective of the occupations we want to train them for. Nonetheless, we must remember that the OES system has been driven by customer requirements.

Too myopic; not exact enough. Those are some of the things I think we've got to think about as we replace the SOC with a new system.

Well, how are we going to go about that? Some ideas have come out as highlights of the conference.

We should aim for a *single conceptual foundation* for the SOC just as the folks who are working on the replacement system for the SIC are looking for a single classification concept. But, in terms of the occupational structures, I don't think we've got to worry too much if we don't find one. Clearly, most of our decisions have been made on the demand side. Maybe there are some supply side uses that we have to think about. This one structure should be big enough to hold both of them. Joel Popkin helped us to understand that there are ways of looking at the Rubik's Cube to see if both of those things can fit in. In summary, we should look for a single classification concept to help guide our criteria that we are going to select for the SOC revision, but not be slavish about it.

Compatible, not integrated lists. Certainly, the idea of dovetailing the DOT and the SOC, and bringing in the other lists, the CIP and so forth, are important objectives, but that doesn't mean we need one all-purpose list that goes all the way down and adds all the way back up again. We need lists that are compatible, that have a structural foundation, and that can be reconciled if we so choose.

The system used in the U.K., which exists in three volumes at the top side makes sense because it is in the same foundation.

Design for all users, but stress statistical uses. The SOC is a standard statistical operation. We ought not to be constructing a system out there that isn't subject to measurement.

Learn from past mistakes; look first to the Census and OES differences. There are real reasons that I mentioned before why OES has made decisions in terms of the occupations it covers and does not cover, and the same with the Census Bureau. Let's learn from those differences, integrate them into the process, and balance modernization with consistency. Certainly, it's very important for purposes of projections to have a consistent time series, but we've got to be modern.

We've got to be able to associate occupations with industry. People like Seymour Wolfbein, who explain data to people out there, and people in your career information systems who explain occupations to people in non-technical terms need to be able to link occupation and industry.

We need flexible aggregations with a fixed structure. Maybe what we need is a 9-digit code that has lots of zeroes in the aggregations.

There's always a need for an *outside quality audit.* We've got to build that in from the beginning. We've got to make sure that what we do at the other end is of good quality.

We've got a very limited window of opportunity. I suggest that window of opportunity for all of us in this room and in the United States has the attention of the Secretary of Labor right now. We have a Secretary of Labor who is very interested in this process, personally committed to making a difference. Second, we have a head of steam that comes from this conference, and what we've learned from people in the international community.

I started out very concerned that we needed to have a new system by 1997. I've heard loud and clear through this conference that 1997 isn't soon enough. Something has to be in place tomorrow to support the "one-stop shopping centers" that ETA is establishing, to assist people converting from defense industries. We need interim solutions, as well as a long-term fix. We need to know that we are all moving together in the same direction. So, while the year 1997—a year that the Census Bureau focuses in for the year 2000 census—is a pretty good date for us to focus on for the long-term solutions, we need short-term to have a feeling for where we are going to be long-term. We must get on with these interim fixes, using OES and all the other kinds of notions that are floating around out there from the APDOT report.

In the next few months we've got to get on with the process. An appropriate agency to take a leadership role is the Office of Management and Budget. We always understand, of course, that they are short on resources, and so, there has to be a secretariat function which BLS or other agencies could take on.

This effort would be a little bit different than the function that we've already set up in the area of industrial classification, because there is a much wider, richer group of users that have to be consulted and brought into the implementation process early on. Nonetheless, the economic classification committee has presented a process that seems to work.

And, finally, we must bring in the major integrator—the NOICC-SOICC system. They bring it all together, and they have the institutional knowledge on how things work where the rubber hits the road.

Clearly, the lesson we have learned here is that we can't redesign the SOC in isolation. We have to do this with an eye on the ISCO. Whether or not we accept the ISCO as the general framework for the redesign, an end product has to be internationally comparable. The day in which the United States could develop its own classification structures and live with them is gone. Certainly, NAFTA is going to clearly change that for the North American Continent. We need to have common systems with our neighbors in Mexico and Canada, and, by the way, with our major trading partners, and, by the way, with the rest of the world.

And, in doing so, we've got to understand and learn from the more advanced practices elsewhere. We're very glad that we had the opportunity to hear about those advanced practices this week.

That's one observer's view of where we ought to be going and what we ought to be doing. Echoing Dan's observation, we've got to get about it right now. I think that we've got a very short period of time in which to make some real difference. The Bureau of Labor Statistics commits itself to get on with this integrated look at where we ought to go.

Submitted Comments

Introduction

A concluding section contains comments submitted by eight conference participants, some of whom did not make formal conference presentations. Although the volume includes audience questions and comments, this section provides an opportunity for conference participants to set forth their perspectives and ideas on occupational classification in a more formal and complete way than a record of the conference discussion could.

James G. Scoville

University of Minnesota

Principles of Job Content: Conceptual and Operational Basis for an SOC

As first proposed in Scoville (1969), job content is viewed as having two major dimensions: the technical focus of the job which determines the "job family" to which it belongs, and the level of content of the job. These two dimensions determine many of the skill and training requirements of a given job, affect the ways in which compensation is determined, and influence patterns of labor mobility. These two dimensions seem to form the basic structure of the new Canadian National Occupational Classification of 1991, but that is for others to discuss; I would like to review applications and extensions of the basic job content model during the years between 1969 and 1991.

Canadian job content, 1941–61

The first follow-up work to my 1965 dissertation on job content actually preceded the publication of Scoville (1969), the revised version of the thesis. The matrix proposed in the dissertation, as modified by subsequent research on earnings in relation to estimates of GED, SVP, and Worker Traits Requirements, was applied to Canadian data in Scoville (1967). I found: the major impact of slower economic growth in the 1950's (as compared with the 1940's) was in the middle of the content level distribution; there were considerable gender differences, with women more likely to be at the very top or very bottom content levels; there was considerable inter-provincial homogenization of job content over the 20 years; lowest content level jobs in the Personal Services family showed remarkable buoyancy (as they did in the United States as well) in periods of more sluggish economic growth; in comparing U.S. and Canadian distributions by content level, the differing importance of job families has tended to raise and compress Canadian overall job content, while differing level distributions within families have tended to lower overall job content. (This last effect probably reflects operation of a Canadian labor market containing at the time a much less trained and educated work force than in the United States.)

Educational needs of the Ontario labor force to 1990

Burkus (1969) was a more micro report on the educational implications for Ontario of projected economic growth prepared for the Economic Planning Branch, Policy Planning Division, Ontario Department of Treasury and Economics. As Burkus observes: "An industrial break-down of the labour force which classifies workers according to a series of end products is unsatisfactory for our purposes because it does not reveal the technical orientation of the various types of jobs performed" (page 3). Similarly, "occupational data does [sic] not tell us the particular type of function performed or service rendered" and thus is of limited value in planning for education and training specifics (p. 3). Applying the job content method, Burkus concluded: "The percentage distributions [of educational attainments by job family and industry] form a useful basis in preparing projections of educational requirements after labour force demands have been derived by industry" (p. 54).

Work and workers in the Cincinnati Model Cities area

The author was asked to look at the kinds of jobs held by residents of the Cincinnati Model Cities area. Scoville (1971) reported on the first survey of the area; subsequent surveys and resulting reports were intended to provide "a longer analysis of the impact of Model Cities in Cincinnati on the 'quality' of jobs held by residents of the area" (p. 1). What would be the "changes wrought by model cities in the type and content of work performed" (p. 1)? This was a good question, but subsequent studies did not make it to the author; an inquiry has been made to see if the project was ever carried through. As to the 1971 report itself, it showed that the job content model could focus efficiently on the areas of work that were underrepresented (inspection, clerical, education, administration, and research, and design—probably due to low levels of educational attainment in the area) and overrepresented (tools, machines, and personal services). It depicted most graphically the work and earnings prospects in the Model Cities area by comparing overall content levels with those of all urban workers at the 1960 Census.

The microeconomic underpinnings for job content analysis

Scoville (1972) was one product of a USDOL contract with the author in the late 1960's. As the heading suggests, one contribution was to review the theory of job design from Smith to the present, propose a new model in which job design, training breadth, and the allocation of training costs between employers and workers are simultaneously determined by underlying turnover and training cost functions. This provides the theory as to where the various specific jobs are located within a range of "job options" defined by available technology. The

applicability of the model was checked against questions relating to labor mobility, job breadth in the construction trades, and job design in medical care.

But Scoville (1972) had more on its agenda. A practitioner and scholar survey of data users was joined with an overall appraisal of currently available occupational information. This conclusion was reached: "The implications . . . for our occupational data base are quite straightforward: (1) we require considerably increased detail; and (2) this detail must be capable of aggregation in a variety of ways. Data which are based upon specific jobs, firmly placed in the technical context of surrounding jobs and technology, should meet these criteria. Moreover, such data provide the proper base for corollary information on training, wages, turnover, and the other variables [in the theoretical model discussed above]" (pp. 40–1).

Scoville (1972) also addressed the probable source of such improved job-related data, evaluated a variety of competing possibilities, and opted for "an intensive work-related household panel survey" as the best bet. Scoville (1980) re-emphasized these last two issues: the nature and appropriate source of the basic work-related data.

Extensions to developing areas

Scoville (1985) revisited these issues as part of the ILO's project on the revision of the International Standard Classification of Occupations (RISCO). Once again, the focus was on a job content framework as a means of organizing detailed work information, in particular data with a focus on "type of work performed" in developing countries. I proposed that, for those sectors of LDC economies where "jobs" can be spoken of meaningfully, work be broken into major "domains" based on what is being processed and how (p. 10). Within these domains, more specific job families would be identified. Thus, in the domain focussing on "processing information," a job family (or perhaps job clan) focussing on "word processing" could be identified. Within that broad family, we could identify a number of distinct job family modules, each of which is a group of jobs centered around a particular word processing technology. Thus:

WP Module 1	WP Module 2	WP Module 3
Clerical supervisor	Clerical supervisor	Letter writer
Word processor repairman	Typewriter repairman	
Word processor operator	Typist	
Scut labor	Scut labor	Peon

(From Scoville (1985), p. 11 as modified)

"In this example, Module 1 would be found . . . in the offices of the country's Central Bank, Presidential Palace and Army Command. Module 2 would appear generally throughout business and government bureaux. Module 3 would be found on the sidewalks and in the streets of the bazaar." (p. 11)

Scoville (1985) concluded that a shift of ISCO towards type of work performed is "fully warranted, and . . . suggested a formulation based on job content, recognizing that jobs belong to families clustered hierarchically about a particular technology or other technical focus" (p. 15). The matrix approach to job content may be applicable in the modern sector of Afghanistan or Zimbabwe as in the United States and to the same kinds of problems.

Concluding remark

When a preliminary version of the Canadian NOC arrived in my office, I wrote to long-ago thesis advisor Prof. John Dunlop "So far as I know, this is the first recognition of these ideas [the job content matrix approach] by employment officialdom anywhere in the world." Today's session will help us tell whether it was worth waiting for, or whether I was deservedly a prophet without honor—in his own country or anywhere else—for some 25 years.

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The Classification of Occupations for Healthcare and the Development of a Single Terminology for Occupations

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Health care interest in occupational classification

Since 1985, ASTM (American Society for Testing of Materials) has been developing standards for Computer Based Patient Records (CBPR). In the course of adopting common conventions for automated primary records of care and other paper record systems (1,2), it became clear to members of the ASTM E-31.12 Subcommittee on Computer Based Patient Records work group that the data elements denoting occupation (largely: current occupation, past occupations, family member occupation) required a single unified terminology. It was recognized that the National Center for Health Statistics, the Bureau of the Census, the Office of Management and Budget and the International Labour Organization all had classification systems and terminologies for occupation. Moreover, as part of the gathering of a health history in the course of constructing an individual's CBPR, the individual's job history, complete with job title and job classification, have to be recorded. These job/occupation attributes, as it is well recognized, are also used widely in personnel management and economics as well as in demography. There is, therefore, no reason for a separate health classification and naming of occupations even though since the 1970 OSH Act, health care practitioners have been trying to characterize health problems due to the work environment. Since health effects are recorded in the primary record of care and in the longitudinal health record [Note the use of these generally defined terms!], the terms used for the record must be in common with their usage in business and government, if there is to be a chance of relating detailed health conditions to resources and policies applying to the work environment. For this reason ASTM E31.12 has attempted to synthesize a unified terminology from the existing lexicons that can rapidly be the basis for healthcare information management common conventions in the near term and yet be able to be transformed into a compatibly worded terminology based upon the national and international efforts targetted for 1997. A draft standard (3) of coded values to be used in manual and automated health records of care is now being circulated for ballot which contains the terminology developed to apply to the occupation data elements.

The Basic approach

Our modest effort was developed using the database tools developed for automating the Department of Veterans Affairs healthcare facilities and now used by the U.S. Department of Defense and the Indian Health Service. The basis for classification uses the following major occupation groups: Administration/Management, Professional/Technical, Clerical, Service, Sales, Agriculture, and Manufacturing/Transport that are used in all of the present classification systems. Use of the terminology in health care data collection requires intuitive, systematic wording that avoids "codes," which are surrogates and should be invisible to the user, leaving the term to be as intuitively obvious as possible, resulting from the systematics of its wording. We have used abbreviations to shorten the overall maximum length to 65 characters for readiblity and understandibility. Examples of wording are shown in table 1.

Table 1. Occupations

Admin/manag: Manager financial
Admin/manag: Tax examiner/collector
Prof/tech: Biochemist
Prof/tech: Archivist
Prof/tech: Health, dentist, prosthodontist
Sales: Salesman, real estate
Sales: Auctioneer
Clerical: Supervisor, general office
Clerical: Teller
Service: Supervisor, guards
Service: Bailiff
Agriculture: Fisherman
Agriculture: Sprayer/Applicator
Manuf/transport: Millwright
Manuf/transport: Repairer/installer, telephones

Problem areas

In addition to the uneven granularity, each of the groupings suffers from lack of clear criteria for assigning an occupation name to the group and resolving priorites in selecting the major grouping criterion. A major classification question is: When does the nature and level of duties move an individual into the Administrative/Managerial domain? Another question is: What criterion determines Professional/Technical duties instead of Clerical, Service, Agriculture, or Production/Transport responsibilities?

Involvement of all activities

It is recognized that the categorization of occupations applies to both the practitioner and nonpractitioner segments of the healthcare system and will be used both in CBPR systems and supporting resource management systems for a variety of clinical as well as resource management functions, including electronic billing and fiscal. Existing working relationships of ASTM E31.12 with ANSI X12 Electronic Data Interchange (EDI) work groups already exemplify the beginning of this effort and a powerful, systematic terminology for occupation, consistent with existing professional specialty categories, will increase the power of systems for these purposes.

National and international health care informatics standards

It is appropriate here to outline the existing national and international health care informatics standards efforts and to sketch the directions in which these are heading in order that this audience can sense how the two efforts can be coordinated and lead to mutual benefits. In 1985, after 14 years of focussed efforts in developing standards for ancillary health care information systems such as clinical laboratories and pharmacies, ASTM established a series of Subcommittees having interest in the full range of patient care data issues. Several health-care professional organizations have been involved. A list of some of those standards appears in table 2. In early 1988, an Ad Hoc organization of existing formal voluntary consensus standards bodies active in health-care informatics, shown in table 3, formed the Health care Informatics Standards Coordinating Committee (HISCC). The formal standards coordination activities were later assumed by the ANSI Healthcare Informatics Standards Planning Panel (HISPP) formed in March 1992. That effort will probably lead to the formation of a U.S. Technical Advisory Group (TAG) to the International Standards Institute (ISO) Technical Committee (TC) on Health care Informatics that most probably will be formed shortly to deal with this fast moving subject. All groups are developing common models and terminology to explicitly define common concepts. The Computer-based Patient Record Institute (CPRI) was formed, as recommended by the Institute of Medicine report (4), to foster education and collaborative standards efforts and to raise funds to assist standards projects.

Table 2. ASTM Health care Informatics Standards

E-1238	Standard specification for transferring clinical observations between independent systems
E-1239	Standard guide for description of Reservation/Registration-Admission, Discharge, Transfer (R-ADT) systems for automated patient care information systems
E-1384	Standard guide for description content and structure on an automated primary record of care

Table 3. HISCC member organizations

American Society for Testing of Materials (ASTM)
American College of Radiology/National Electrical Manufacturers Association (ACR/NEMA)
Health Level Seven (HL-7)
Institute of Electrical and Electronic Engineers Medical Data Standards Project (IEEE-MEDIX)

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Kay Raithel

Director, Missouri Occupational Information
Coordinating Committee

Those who are first learning about occupational classification are often confused by the multitude of occupational coding structures. They ask, "Why don't we have just one occupational classification system?" I hope we will soon be able to tell them that we are working together to develop one system which we can all use for statistical and descriptive purposes. The window of opportunity is here.

The paper presented by the Economic Roundtable recommended that we, "Collect occupational and labor market information using the same occupational classification system. Coordinate the occupational structure used in the Occupational Employment Statistics (OES) and U.S. Census of Industries and Occupations to generate a single set of occupations, obviating the need for crosswalks" (Drayse 91).

The need for crosswalks between occupational coding structures in the United States should be eliminated. A core of occupations, or a "Tier One," as it is referred to in David Stevens' paper, should be selected for which employment statistics and occupational characteristics can be collected (Stevens 25). This core of occupations could probably include less than 3,000 occupations. Most users would accept this level of occupational detail, particularly if all the data could be kept current and all the data collected could use the same coding structure. The 744 occupations currently used for the OES could serve as a beginning core, but the "All Other" categories would need to be separated into the "important" occupations which are hidden there. These "All Other" categories are often large and do not provide meaningful information. The National/State Occupational Information Coordinating Committees (NOICC/SOICC's) are available to assist in the identification of core occupations.

As indicated by participation at the conference, work to develop this core of occupations should be coordinated with other data producers: Bureau of the Census, Immigration Services, Employment Security Agencies, Social Security, Occupational Safety and Health, Vocational Rehabilitation Services, and others. Major user groups also need to be involved in this process to assure that the new coding structure will be accepted and used.

There has been much discussion of skills and skills transferability. The new coding structure must include information on skills as described by the APDOT report and the Economic Roundtable paper. Estimates of education levels required for entry into occupations are important, but they are not necessarily a proxy for skills. The content model proposed in the APDOT Final Report includes measurements for workplace basic skills, cross-functional skills, and occupationally specific skills (32). Additional work is needed to develop accurate and affordable methods to determine the level of these skills across all occupations. The Economic Roundtable paper also underscores the need for good information on skills and educational levels. "Knowledge about occupational skills, and requisite training and education, is critical to workers entering the labor market, or seeking to transfer skills across jobs and possibly across occupations. This information is especially important when jobs, occupations, and labor markets are transformed by organizations adapting to a changing economic environment" (Drayse 76).

Our relationship to the global economy requires us to look also at how other countries classify occupations. The International Standard Classification of Occupations (ISCO–88) seems to be a classification with which our coding needs to be compatible. Since our system will be more detailed, we should be able to aggregate to their approximately 371 occupations.

In describing an intuitive classification of occupations, the paper by Conrad and Tonn makes a very important statement: "Whether formal or intuitive, good classification systems highlight the commonalities within groups of objects and the difference between groups of objects by attaching labels to groups in ways that are meaningful to the users of such systems" (Conrad 1). If the new occupational classification system developed for the United States can accomplish this goal at the same time that we develop one comprehensive system of occupational statistics and characteristics, we will be better able to prepare our work force for the jobs of the future.

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The Career Case for Compatible Classification

In his opening remarks to the conference, Mr. Plewes pointed out that career information is a dominant current and future component of occupational information use. To quantify this point a bit, in 1992, State-based Career Information Delivery Systems (CIDS) reported that they were located in almost 19,000 sites across the country, serving at least 4.5 million people who sought information about planning a career, preparing for work, and finding employment.

The advances of technology and the widespread availability of computers today increasingly allow individuals to obtain information about careers from sophisticated information delivery systems. As far as the user can tell, career information provided through these systems is accurate, complete, and up to date, and they have a right to this belief. A peek behind the scenes, however, indicates how difficult it is to develop and deliver good career information. If we think of career information as a jigsaw puzzle, we have pieces that will not fit with each other and pieces that are missing. Dr. Stevens graphically described these issues in his conference paper, "The Case for Revising U.S. Occupational Classification Systems." I contend that the issues are exacerbated when the information is combined and delivered through a computer. The user is not presented with the obvious differences and time frames of the data sources and cannot judge their validity. The quality of our delivery mechanisms has exceeded the quality of the information being delivered; polished information delivery gives the illusion of accuracy.

In times of high employment, there is no sense of urgency to develop good career information; people are finding jobs, and the economy is moving along quite nicely, thank you very much. Now we are having problems, and the workforce, economy, jobs, and training, are all getting attention, but we can't deliver the information because we don't have what we need. As we attend to improving this situation, we must consider need for the career information from the point of view of Americans who are preparing for and seeking work. Good information will help people make better career and employment decisions, and better decisions will support higher work force productivity.

Given the need for good career information, I would like to illustrate the need for classification compatibility in relation to the development of career information based on my experience in this field.

When the National Occupational Information Coordinating Committee (NOICC) began its support of Career Information Delivery Systems (CIDS), it strongly encouraged the use of the Standard Occupational Classification (SOC) system as the basis for providing career information, in accordance with Federal policy on the use of the SOC. Many CIDS have subsequently used the SOC as the basic organizing structure for occupational information, although they have deviated from that in selected cases based on user needs, much as have the Occupational Employment Statistics (OES) program and the Bureau of the Census.

To prepare a complete description of an occupation, I rely on over 17 different existing national sources of career information. These resources use various occupational classification structures to provide their data, including the *Dictionary of Occupational Titles* (DOT), the Standard Occupational Classification System (SOC), the Occupational Employment Statistics (OES) structure, the census structure, and the Classification of Instructional Programs (CIP). Therefore, to create a single description out of these various sources, I must crosswalk the occupational classification systems used to present the data.

At this point I would emphasize that the discussion of developing a single occupational classification system for the United States must also consider establishing compatibility with the Classification of Instructional Programs (CIP), the classification system used for education and training programs. For a person making a career decision, the education and training that may be required is a critical piece of information, and must be accurately linked to occupations. It doesn't make sense to try to improve the preparation of the work force, and neglect the relationship between education programs and jobs. If education is not a partner in the relook at occupational classification, the results will be severely limited in terms of the social and economic needs that must be addressed.

In a *SOC-based* career information delivery system, the following topics are given as some examples of what information is typically provided about an occupation. Under each topic are noted the resource(s) that may be commonly used (and the crosswalking between resources that is necessary).

Occupational definition. Development of the definition begins with the SOC (very limited information), moves

to a review of related DOT's (SOC–DOT), and includes a review of the OOH (SOC–OOH, no existing crosswalk except through selected DOT's). The definition may also crosswalk to military occupations using the Military Occupation and Training Data (MOTD) database (military-DOT–SOC).

Education. The development of required or related education and training entails matching the occupation to possible programs of study (SOC–CIP), then refining the possible SOC–CIP relationships by examining the National Units of Analysis (SOC–OES, OES–CIP), then relating the occupation to the OOH narrative (SOC–OOH, no existing crosswalk except through selected DOT's). The MOTD may be used to determine if there is military-related training.

Earnings. The most comprehensive and standard national data sources for this item are the Current Population Survey, which uses the census occupations (SOC-census) and the OOH (SOC–OOH, no existing crosswalk except through selected DOT's).

Future Outlook and Employment. The information for this item comes primarily from the Occupational Employment Statistics program which is available at the national and the State level (SOC–OES). Narrative information is also available in printed form from various BLS publications such as the *OOH, Occupational Outlook Quarterly,* and *Outlook 1990–2005* (SOC-publication titles).

These examples demonstrate how many incompatible resources have to be linked to develop an occupational description. What they cannot point out is how incomplete the relationships are in many cases, and how out-of-date the information may be, as in the case of the *Dictionary of Occupational Titles.*

If we can agree on a standard system for classifying, collecting, and describing occupations in this country, which is compatible with the classification structure for education and training programs, we can make significant progress towards giving people complete, accurate, and up-to-date information as they seek to prepare for and find work based on the current and future needs of our economy.

Note

Eleanor Dietrich is currently the president of the Association of Computer-Based Systems for Career Information. In her consulting business, Directions in Work, she develops the occupational database for a national career information delivery system, Choices, and has worked with the National Occupational Information Coordinating Committee on various projects involving the crosswalking of different occupational classification systems.

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The current lack of conformity in occupational classification systems among different statistical programs makes it difficult for government planners, researchers, and other users of occupational data to carry out their work. With current budget constraints facing the Federal government, there is virtually no funding available for a statistical program to collect regular employment data on the more than 12,000 coded occupations in the Dictionary of Occupational Titles (DOT).

Many users of the DOT—such as employment services, labor certification offices, and guidance counselors—make use of less than 10 percent of the detailed occupational information available. Furthermore, some occupations are disaggregated to a much greater degree than others. The tobacco industry, for instance, has 148 different DOT classifications, whereas college faculty have just one classification for all specialties.

The most comprehensive program for collecting occupational employment information is the Occupational Employment Survey (OES). With approximately 800 occupations, it has more detail than the census/SOC in most areas, but less detail in other areas, such as sales/marketing. Expanding the codes from the OES to include some of the census/SOC codes not covered by the OES would result in a very useful classification system for labor certification, job matching, labor market information, and many legal uses such as determining economic loss for disabled workers. Such a classification system would have fewer than 1,000 codes.

A database could be developed, listing detailed occupational titles and characteristics within each of the codes similar to the census detailed occupational classification system. Such an approach is economically feasible and could meet user needs while vastly simplifying occupational classification. A crosswalk could also be developed to link the database to international standards such as ISCO–88.

As we move ahead to new classification systems, we should also be aware of the need for some users to be able to compare historical data to current data. Statistical agencies have been very lax in providing information that would permit users to assess the effects of occupational changes. For example, when the 1990 census classification codes were announced, information was provided only on what the Census Bureau deemed major changes. But Neal Rosenthal of the Bureau of Labor Statistics indicated at the conference that his staff has documented at least another 80 significant occupational classification changes.

Even if a comparison were made, however, of all of the classifications in each of the two several-hundred-page books for 1980 and 1990, there would be no way to determine in any given case how important the differences are, because not enough information is given about what underlies the changes. It is not until users encounter problems that important differences are discovered.

One example that I discovered in my research was ticket agents. According to the BLS publication *Employment and Earnings*, employment in this occupation doubled from 1991 to 1992. Given what we know about the problems facing the airline industry, this seems counterintuitive. It turns out that BLS used different census coding indexes for the 2 years. The 1990 census occupational coding index defines ticket agents as "trip counselor auto club—any industry," whereas the 1980 definition is much more narrow.

In 1989, the Census Bureau published a comparison of the 1970 and 1980 censuses. If the same thing holds true for the 1990 census, we will not be able to make historical comparisons until 9 years after the data are collected.

The Iowa Crosswalk Center puts together crosswalks between censuses, but their information is not useful in the case of the 1980 and 1990 censuses because they were never given explanatory information on the detailed changes.

Even if that information were available, however, we would still have the problem of making comparisons between the 1990 census and the Current Population Survey, because of differences in the collection and coding of the information. Both surveys use an identical system, but they have differences in coding. For example, the 1990 CPS lists four times as many special education teachers as does the 1990 census. The discrepancy results from differences in methods of data collection: the 1990 census was done by mail-in questionnaire, and when a respondent indicated the occupation "teacher" it was coded as "elementary school teacher." The CPS, on the other hand, uses interviewers who ask more detailed questions and can classify occupations more specifically.

If a new, smaller, occupational classification system is ultimately developed, it would be useful to provide information to users on differences in collection methods among the different surveys, so that users can make more

informed decisions when they need to match occupations from different sources. It would also be useful to carry out surveys collecting characteristics on the different occupations, such as level of education or skill required, experience required, and other characteristics as recommended by the Advisory Panel on the Dictionary of Occupational Titles.

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U.S. Occupational Classification System Revision Comments and Recommendations

Introduction

It was evident at the recent International Occupational Classification Conference that major changes are sorely needed in our occupational classification system. The Interstate Conference of Employment Security Agencies, Inc. (ICESA) concurs that now is the time to start the process of revising the Standard Occupational Codes and the occupational classification system.

Challenge

Millions of people in the United States depend upon occupational information to make decisions which have a direct, profound impact on their lives. Meaningful decisions are made by companies based upon occupational information. Professionals spend time and dollars gathering, preparing, analyzing, and presenting occupational information to individuals facing important personal decisions, companies, and policy makers. Despite our best efforts, these critically important decisions are based upon inadequate, or even misleading, occupational information.

It is clear that without fundamental changes, our current occupational information will fail to adequately meet our future needs in the global economy.

Principles

Our "raison d'etre" is to produce and make available to all potential users the highest possible quality of occupational data and information. Secretary Reich reminded us at the conference that "good policy depends upon good data" and Neal Rosenthal identified the key problem as being "how to use data from different sources." Quality occupational data permits better policy, improves personal decisions about career and education choices, and enhances the job matching process. Improved occupational information is vital for America's workers to adapt to the global economy.

The focus must always be upon the users. There is a broad spectrum of intermediate and end users of occupational information, including policy makers, data processors, statisticians, analysts, placement specialists, employers, counselors, students, and job seekers. But, for any decision we make, the fundamental question we must always answer is: What will be the impact of our actions upon those individual citizens and taxpayers whose lives this will directly affect?

Goal

ICESA concurs with those participants at the conference who argued that the major goal must be to develop a new, unified system of classification, which all would be expected to use.

Concerns

The conference provided the opportunity to discuss and enumerate many current occupational classification problems. During these discussions several problems surfaced that ICESA believes need to be addressed before we can adequately provide a comprehensive occupational information system. We will only highlight here a few that from our perspective seem particularly relevant and troublesome.

Inadequate Data: Some of the occupational information we currently provide is inadequate, inaccurate, or misleading. Inadequacies in our current classification system contribute to this problem. Our future system should contribute to gathering and disseminating accurate and relevant information.

Crosswalks. Fragmentation and crosswalks result in a considerable waste of time and energy. Trying to relate inconsistent data with different coding structures and nomenclature results in inefficiencies. A new classification system should insure uniformity to help us better utilize existing data.

Reinvent the wheel? Given the magnitude of fundamental changes that are needed, the temptation will be to start all over again. But there is already a wealth of experience and expertise available on the service delivery side, where professionals wrestle with classification issues on a daily basis as they deal directly with the public. This expertise should be utilized in redesigning a new classification system.

End users. In designing the classification system, the needs of the end users of the data to be produced should be paramount. It cannot necessarily be assumed that meeting the needs of intermediate users, such as statisticians, will also meet the needs of end users, such as job seekers.

Skills. The idea of basing our classification system on "skills" rather than work tasks was generally well received at the conference. In a transitional economy, it certainly has considerable merit as a better way to facilitate transferability of workers to different industries. But, what is a "skill"? No consensus was evident among the many practitioners and academics on its definition or parameters. At a minimum, a classification system must address two prominent components— "type of skill" and "level of proficiency"—if we are to optimize the skill portion of any classification system. We need a much clearer understanding of what a skill-based approach is, and the implications of using it, before we base our entire classification system on it.

Economic transition. The future classification system must contribute to meeting the challenges of an economy in which some entire economic sectors are declining. Whether it is based upon skills or work tasks, the classification system must facilitate the process of transferring workers from one occupation in a declining industry to a different occupation in a growing industry.

Distribution. The type of classification system adopted determines how data can be distributed to users. Our current distribution methodology needs to be improved. We are not doing an adequate job of getting the information we have to those who need it in an effective manner. "One-stop shopping" is one of the options we should pursue. Components of the classification should be organized so that they facilitate flexible and rapid automated retrieval and presentation of data. The new classification system should contribute to effective distribution of data.

Longitudinal data. Projections of occupational change is one of the most essential pieces of occupational information used. Whenever a change is made in the classification system, it makes it difficult to maintain historical and longitudinal data upon which such estimates may be made. The process of developing a new classification system should take into account this implicit cost and mitigate it as much as is feasible.

Recommendations

Uniform system. It is clear that a single uniform system is needed. Many of the taxonomies and recommendations presented at the conference have considerable merit and the implications and details for implementing them should be explored. The lessons of Frugoli and others about the maldistribution of sectors in our current system and the need for restructuring them to reflect needs in our current economy also should be heeded.

More research needs to be done on how specifically to develop a compatible, unified redesigned classification system that can be used both for household surveys of individuals (such as CPS) and surveys of employers (such as OES). The default should not be simply that the most aggregated level of detail is what can be collected from household surveys. Other nations, such as Australia, add additional items to their census questionnaire that enables them to code individual responses with greater precision. In addition to requesting job title, they ask for major duty or task, type of employer, and name of employing firm.

One approach worth careful consideration would have four layers of detail. The first level would support a household survey. The second level would contain additional detail from employer surveys. However, the match between the two would be seamless, that is, two, three, or more detailed occupations in the employer survey would add only to exactly one occupation in the household survey level.

The third level of detail would be for the Database of Occupational Titles. The classification system developed for the data surveys would serve as the structure for the DOT. Disaggregations for further detail on characteristics of specific occupations could be developed, if they remained strictly within the framework of the unified classification system.

Finally, to meet the need for currency, at the fourth and finest level of detail, a classified index of occupational titles would be maintained. The classification system cannot be revised or an occupation added to the DOT every time an employer uses a new job title. It is relatively easier to keep current an index than a descriptive database or a classification system. Job title changes which reflect actual changes in work content could be maintained in an index of new titles and correlated to the classification system. Now, only the Census has a classified index of titles. The current DOT tries to serve as a classified index with its alternate and related titles, but their location in the text makes it impossible to use them for the index function. Instead, the index could be used as a source to indicate when an occupation might need to be reviewed or updated. New titles from the Census, the OES surveys, and job analysis studies would all go into a single classified index serving the single unified classification system.

The hierarchical structure of the classification system should be intuitive and user-friendly. This would facilitate both use of data classified according to that system and more accurate reporting and coding of data using the system. Now, the current SOC works better as a coding funnel than the terminology used in the hierarchical structure of the OES. Skills Based: The current occupational classification system is inadequate to meet the needs of the job matching process. In our changing labor market, where the unemployed too often cannot return to their former job, or even industry, it is critical that a new classification system be designed which integrates skills as a primary component, to facilitate transferability of workers from declining economic sectors to growth sec-

tors. As Dixie Sommers demonstrated at the conference, several States (Ohio, Utah, and others), have followed Canada's lead in using the skills approach in their job matching and placement process. One of the first priorities of the redesign should be to determine how best to incorporate skills into the classification system.

One approach may be to start with the development of a Dictionary of Skills which includes detailed descriptions of perhaps 100–200 discrete skills. These skills would be identified in and used in data gathering instruments and in job orders and job applications and would form the basis for survey databases and an automated job matching process. Conceptually, it would be possible to combine these skills in hundreds of thousands of ways. But in practice, they would be combined into clusters, based upon skill types and skill levels. Each skill cluster would be an occupation, roughly analogous to current SOC and OES occupations and codes.

International compatibility. The need to be compatible with international classification systems was evidenced by the comments of our foreign guests at the conference. The requirements of inclusion in the global economy also argue forcefully that our system should be as compatible as possible with the European Community version of the International System of Classification of Occupations (ISCO 88 (COM)).

Coverage. Virtually all occupations should be included in the new classification system. An emphasis on new and emerging occupations is essential. The rising proportionate increase of the underground economy and the unemployed homeless suggest a need to somehow find a way to reintegrate to the extent possible those in the nonformal sector into our mainstream economy. A skills based classification system could contribute to solving this complex problem. As Mr. Garcia of Mexico indicated at the conference, perhaps the experience of third world countries and the occupational methods used there may also be useful in addressing this issue.

Wage data. The basic structure and the coding system of an occupational classification system should be in part determined by compensation level. For example, analysis of a given occupation which has differing skill or responsibility levels (for example, apprentice, journeyman, and professional) may result in a tri-modal distribution of wages. That fact suggests the desirability of expressing that occupation as three separate occupations, or at least as three distinct levels. Clustering these disparate levels into a single occupation renders meaningless important distinctions which should be made when applying the data to policy or career/job decisions.

One of the most critical gaps we have in current information, which limits our ability to classify occupations, is national, state, and area-specific occupational wage data. Before a new classification system is developed which takes into account differing wage/skill/responsibility levels, an evaluation of the use of the OES wage data survey and special surveys in providing this essential information should be conducted. A cost-benefit analysis of adding occupational codes to the unemployment insurance quarterly tax return and wage report should be explored. There are obvious technical, organizational, political, and employer resistance barriers to implementing this approach. But, if successful, it is possible to produce a database of occupational wage data based upon a census (not a survey), with timely quarterly or annual data (not every 3 years), with actual wages (not arbitrary wage groups). Such an approach has the additional advantage that it could actually decrease the employer's total reporting burden, while increasing the value of the data available to them and to job seekers. Integrating the experience and expertise of state and national OES staff with the ES–202 staff could be an invaluable asset in insuring accuracy and consistency of coding.

Alaska has paved the way since 1986 by successfully pioneering a unique approach, the Occupational Data Base (ODB), to produce occupational wage data. The primary data source is the employers' quarterly UI report, the state DOL wage file, which includes information on current earnings, occupations, and industry, as well as employer and place of work. The occupational identifiers in this system produce a database rich in analytical capabilities. Adding an "hours worked" component could offer an even greater wealth of information. This experience should be carefully studied and the lessons learned from it incorporated into the reclassification process.

Automation. Automation is essential. The goal should be to put the control of the use of the data in the hands of the users and let them get the information they specifically need in the format that is most useful for them. It would be a mistake to involve the automation component only after the reclassification has been finalized. Technical data processing experts with experience in developing automated applications specifically for the delivery of occupational information should be an integral part of the process from the outset. It is essential that before the new system is adopted as the Nation's sole system, a Beta version be extensively tested in practical applications in States.

Titles. In the new classification system, titles should be short and easily understandable in the common vernacular. Detailed distinguishing characteristics are better placed in the occupation description, not in the title. For example, by eliminating "except . . ." and "technologists" from the title, the current OES occupational title "chemical technicians and technologists, except health" could become the more readily understood "chemical technicians." To make titles more understandable to the public which use them, commas in titles

should also be eliminated. For example, "estimators and drafters, utilities" would be better expressed as "utilities estimators and drafters."

Residuals. A better method of handling residual "all other . . . ." categories should be developed. You cannot train or hire someone to be an "all other . . . ." anything. A better method of classifying generalist occupations used especially by small employers also needs to be found.

APDOT Recommendations: The excellent work done by the APDOT should be analyzed in relation to this effort and its recommendations should be given serious consideration.

Implementation

A formal interagency group should be established, similar to the current Economic Classification Policy Committee, to provide broad, general policy direction to the entire reclassification process. It is essential that this group represent all stakeholders in occupational classifications, including representatives of states and users.

An SOC Joint Technical Work Group should also be established to work jointly with Federal partners to provide technical staff assistance and direction. Information from this joint work group could also serve as input to an ongoing process of future efforts to revise the SOC. The mission of the Joint Technical Work Group should be to coordinate the States' role and to provide staff assistance in the process of revising the SOC and improving occupational information. In a period of tight Federal budgets, it could assist in utilizing state resources and provide a linkage between the top policy level and end-users. It could also provide feedback and test new systems. Specifically, it could provide expertise and staff assistance in the process of determining the new occupational classification system, codes, titles, descriptions, and data elements.

The composition of the Joint Technical Work Group should include at a minimum representation from ICESA, states (LMI and ES), OA Field Centers, NOICC, SOICC directors, CIDS, the Utah MicroMatrix Support Center, and the Iowa Crosswalk Center. To assist the Joint Technical Work Group, at least four technical working subcommittees should be organized to assist and make recommendations in the areas of (1) classification, (2) data uses and users, (3) statistics, and (4) automation and delivery system.

In concert with proposed changes by federal partners, as critical proposed changes in the revised SOC are decided upon by these groups, they should be placed in the Federal Register for comments prior to implementation.

Conclusion

ICESA is ready to participate in the essential process of revitalizing and remodeling our occupational classification system. We welcome the opportunity to be partners in this essential process.

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Dimensions of Jobs in the United States: An Expansive Viewpoint

As the 21st century approaches, the United States workforce of the 1990's is being buffeted by numerous, powerful forces. These forces include: Worldwide global economic competition; systemic structural unemployment; increasing levels of job stress and violence; increasing disparities between the economic haves and have-nots; and rapid technological change, led by the microchip. Papers and discussions at the conference touched on these points. My comments provide additional ideas about how new approaches to occupational classification could assist U.S. policy makers in confronting these challenging problems.

Theoretical Viewpoints

An *interdisciplinary theoretical framework* is needed upon which to base an occupational classification scheme robust enough to meet the demands of the new world economy and U.S. worker preferences for more satisfying worklives. The framework outlined in this paper draws ideas from economics, organizational design and behavior, cognitive psychology, industrial psychology, and the world of technology. Due to space limitations, only snippets of ideas from each area are presented below.

Economics and organizational theory

Two trends stand out: the United States is engaged in intense global economic competition; and organizations and careers are undergoing a sea change. Robert Reich is one of the nation's leading proponents that jobs need to be viewed with respect to global competitiveness (Reich 1991). Jobs in the private sector can be put into one of three categories: *Routine production services, in-person services, and symbolic-analytic services.*

The first type of job can be moved anywhere in the world, and indeed, represents the kinds of manufacturing jobs that the United States has been losing in recent years. The third type represents the most high paying and rewarding jobs and are largely the product of superior education. These are the types of jobs that enhance global competitiveness of the U.S. economy. The second type of job provides the support services for everyone else. These jobs are not typically high paying; neither are they easily moved overseas (such as, fast food workers). Income from these jobs is largely tied to the incomes and number of symbolic analysts. From Reich's perspective, occupational databases ought to allow the analysis of the numbers and changes in numbers of jobs in these three categories.

Organizations and careers are rapidly changing. Organizational designs characterized by rigid hierarchies and "smokestack" divisions are quickly being replaced in the 1990's. Handy (1989) discusses new organizational designs and associated jobs. *Shamrock organizations* have a small core and a large number of "suppliers." *Federal organizations* are composed of "a variety of individual groups allied together under a common flag with some shared identity." *Triple I organizations* are based on intelligence, information and ideas.

He points out that new jobs in new organizations will resemble inverted doughnuts, where one knows specifically the middle portion of one's job but other aspects are left undefined and open to initiative. He also points out that workers, even in the core organizations, will frequently change career paths due to changing economic situations, age, and changing personal preferences and family circumstances. Thus, from Handy's perspective, it is important to understand whether jobs are: In the core or the periphery; likely to be stable or short-term; well-defined or open to interpretation and initiative; and require skills that can be easily transferred to other jobs and industries.

Cognitive psychology

This viewpoint holds that it is important to match fundamental human cognitive abilities with jobs. Failure to do so results in an inefficient use of human talent and, some may argue, is also morally unsatisfactory. It can be argued that a major problem with the economy is that, indeed, large numbers of people are placed in jobs for which they are not cognitively well suited.

We adopt the viewpoint that people possess a complex set of *multiple intelligences*, a set which is much richer and more sophisticated than posited in traditional theories of human intelligence. Howard Gardner of Harvard University and his associates are the leading theorists in the area of multiple intelligences (for example, see Walters and Gardner 1986). They theorize the humans possess seven fundamental intelligences: *Musical, bodily-kinesthetic, logical-mathematical, linguistic, spatial, interpersonal, and intrapersonal.* The first six should be self-explanatory. The seventh relates to the ability for self-introspection, which facilitates the initiation of behaviors which will mostly closely satisfy a person's psychological needs. These seven intelligences are hypothesized to be

independent of each other and were distilled from numerous sources (such as, brain-damage studies, cross-cultural studies).

Each person possesses different levels of these seven intelligences. Tests can determine to a satisfactory degree a person's intelligence profile and, if aggregated, could be used to describe the cognitive capabilities of the labor force. If information about the intelligences needed for the various jobs offered in the economy could be ascertained from an occupational classification scheme, then the balance between what workers have to offer and what the jobs require could be evaluated.

Industrial psychology

This viewpoint holds that in an advanced and affluent economy jobs should be satisfying in ways that extend beyond pay and benefits. To a distressing degree, this is not the case in the U.S. labor market. For example, Schor (1992) discusses how employed Americans are overworked, to the detriment of the work and personal lives. It can be argued that satisfying jobs are intrinsically linked to higher productivity as well as increases in the overall quality of life.

Karasek and Theorell (1990) have developed a specific list of job attributes related to a healthy worklife. For example, better jobs: Allow workers more control over their jobs; provide job security and a strong social support system; and allow employees to develop new skills. It should be noted that these researchers have developed a data collection instrument that incorporates these job characteristics. Future occupational classifications should provide these kind of data.

The world of technology

Technology is omnipresent in our society. It is the basis for our high standard of living and for both positive and negative aspects of worklife and productivity. Indeed, it can be argued that a study of jobs and technology would reveal a startlingly complex, irreversible dependence upon technology within the U.S. economy. Technology also plays an important role in international competitiveness, and the evolution of new types of organizations and jobs (for example, Zuboff 1988; Tonn et al. 1992).

Technology is changing rapidly, especially information technology. Thus, it is important to regularly assess the relationships between jobs and technology. It would be especially helpful for a new occupational classification scheme to possess a technological component. For example, the technology may augment one or more aspects of a user's intelligence (such as an expert system) or amplify the user's physical capabilities (such as a bulldozer). Many jobs are concerned with designing, operating, administering, and maintaining technology.

Concluding Remarks

It is unclear whether one can extract from the current occupational classification schemes (or even the skill-based schemes proposed at the conference) information pertinent to all of the four viewpoints mentioned above. One reason is that attributes of the jobs that compose occupational classification schemes may be inconsistent with the attributes associated with these viewpoints. A second reason is that, by tradition, occupational classification schemes use job "labels" that are common in everyday language but may be erraticly used in the workplace and not easily related theoretically to the viewpoints presented above.

For these two reasons, it is recommended that the focus of a new classification scheme be on job attributes rather than job titles. Table 1 presents examples of job attributes associated with the viewpoints discussed in this paper. Once a set of robust job attributes is arrived at, along with values for the attributes, then any job should be describable using this system. To study the labor market from various perspectives, one only need to aggregate jobs into categories whose job attributes are related to the important aspects of the driving viewpoint.

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Table 1. Examples of job attributes

Economics and organizations (Reich 1991) (Handy 1989)	Cognitive psychology (Walters and Gardner 1986)	Industrial prcychology (Karasek and Theorell 1990)	Technology (Tonn et al. 1992) (Zuboff 1988)
1. Repetitiveness of task	1. Problem solving ability	1. Decision latitude	1. Augments intelligence
2. Reading skills	2. Ability to retain technical knowledge	2. Skill discretion	2. Amplifies physical capabilities
3. Computational skills	3. Ability to write	3. Decision authority	3. Perform maintenance
4. Level of supervision	4. Ability to verbalize	4. Psychological demands	4. Design technology
5. Relationship to customer	5. Spatial skills	5. Job insecurity	5. Administer technology needs/inputs
6. Problem solving	6. Commonsense judgment	6. Physical exertion	6. Operate technology for use by others
7. Problem identification	7. Work with others	7. Hazardous exposures	7. Automates routine job activity
8. Strategic brokering	8. Cooordinate work of others	8. Self-income	
9. Teamwork	9. Creativity	9. Social Support	
10. Communication skills	10. Physical coordination		
11. Level in management	11. Physical strength		
12. Job discretion	12. Physical stamina		
13. Percent of job undefined	13. Musical skills		
14. Control over resources	14. Ability to introspect		

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